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FACTORS CAUSING VARIATIONS IN EARNINGS AMONG DAIRY FARMERS IN SOUTHEASTERN MINNESOTA

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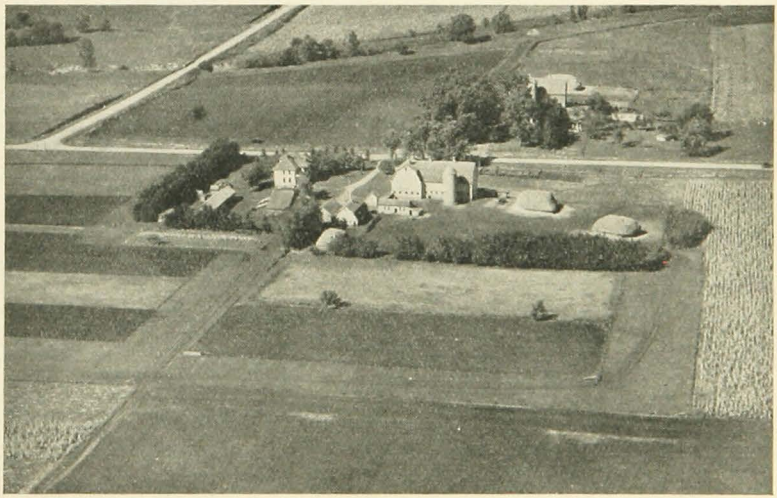

UNIVERSITY FARM, ST. PAUL

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FACTORS CAUSING VARIATIONS IN EARNINGS AMONG DAIRY FARMERS IN SOUTHEASTERN MINNESOTA[1]

G. A. POND, W. P. RANNEY, and C. W. CRICKMAN

INTRODUCTION

Nature and Purpose of Study

Every study of farmers' earnings reveals a wide variation among farmers, even in the same community where natural and economic conditions are fairly uniform. This variation is found in years when weather and price conditions are favorable to agriculture as well as in years when the reverse is true. Even in the most favorable years some farmers fail to receive sufficient income to cover all costs incurred in their business, whereas in highly unfavorable years there may be an occasional man who has a substantial balance on the profit side of the ledger. This variation is especially marked under a diversified system of farming.

It is the purpose of this study to analyze some of the major factors causing these variations in earnings among a particular group of farmers and to point out the extent to which they are the result of differences in practices or methods of management within the control of the individual farm operator. Insofar as these factors are within the control of the farmer, a full analysis of them and their effect on earnings should prove useful to the farmer in this area who is seeking to increase his earnings, and to the extension worker advocating the adoption of better farm practices. Such an analysis should be especially useful in interpreting the results of farm account book records and using them as a basis for improving farm organization and farm practice.

Source of Data

The data used in this study were obtained in an accounting study of dairy farms in southeastern Minnesota, conducted co-operatively by

[1] This is the first of a series of publications dealing with factors affecting the organization, productive efficiency, and earnings of dairy farms in southeastern Minnesota. Later bulletins will be devoted to a more detailed analysis of crop and livestock practices, the efficient use of labor, power and machinery, the control of expense, and the use of farm records in improving and replanning the farm business. These studies are based on records kept by farmers co-operating with the University of Minnesota Department of Agriculture and the United States Department of Agriculture in a farm management service project. It is suggested that the reader study rather carefully the description of the source of data and of the farms and area studied in this bulletin as this will not be repeated in succeeding bulletins.

the Division of Agricultural Economics and the Division of Agricultural Extension, Department of Agriculture, University of Minnesota, and the Division of Farm Management and Costs of the Bureau of Agricultural Economics, United States Department of Agriculture. Records were obtained from 124 farmers in 1928, 172 in 1929, 180 in 1930, 147 in 1931, and 143 in 1932. Only those farms on which dairying was a major enterprise were included in the study. The counties in which these farms are located are shown by the heavier shading in Figure 1. The location of the farms within these counties is shown

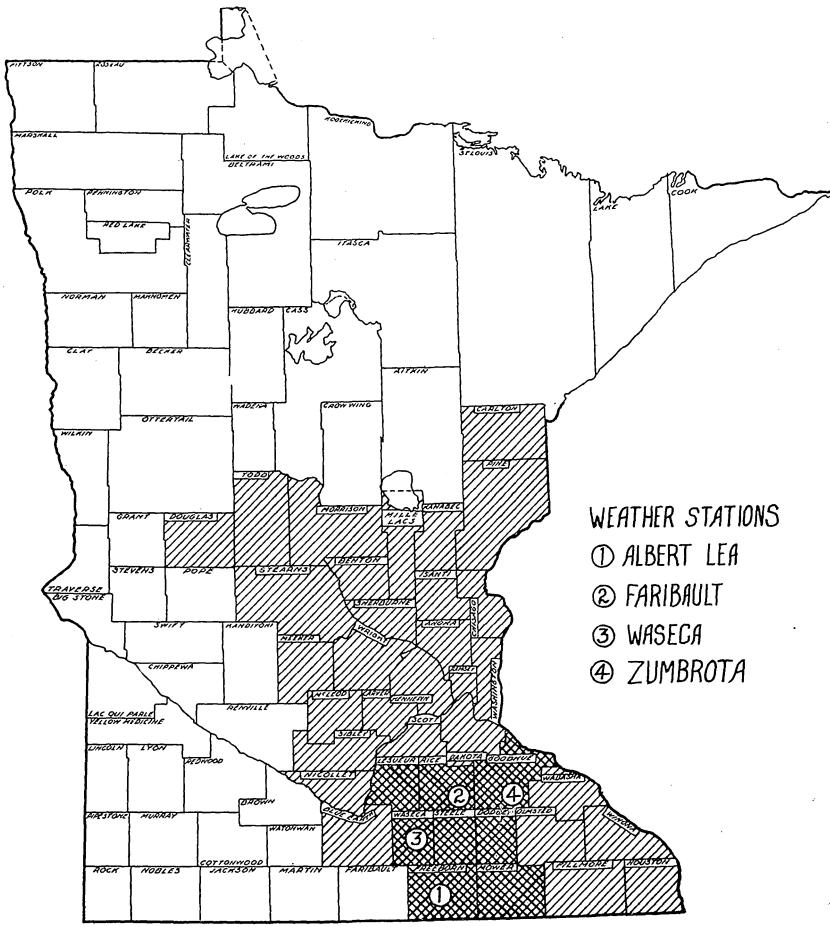

Fig. 1. Location of Counties Covered by This Study

The shaded area includes all counties in the state which were reported in the 1930 Federal Census as having five or more dairy cows per 100 acres of land in farms. The eight counties from which the farm records used in this study were obtained are indicated by the heavier shading.

in Figure 2. The number of records obtained each year in each county is given in Table 1. There was some change in farms from year to year. The 766 yearly farm records secured cover 35 farms for five years, 20 farms for four years, 59 farms for three years, 129 farms for two years, and 76 farms for one year.[2]

Table 1

Number of Farm Records Obtained by Counties and by Years

	Rice	Steele	Free-born	Waseca	Dodge	Good-hue	Le Sueur	Mower	Total
1928	29	27	20	27	16	5	..	..	124
1929	37	30	23	38	29	15	..	..	172
1930	36	32	29	32	34	17	..	..	180
1931	22	18	26	11	17	33	12	8	147
1932	22	21	24	10	15	31	11	9	143
Total	146	128	122	118	111	101	23	17	766

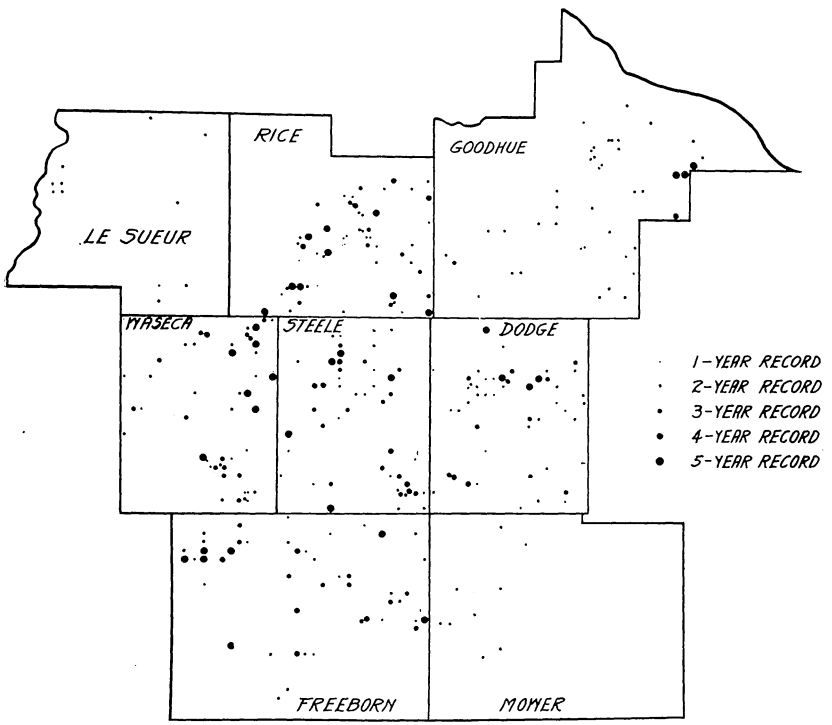

Fig. 2. Location of Farms Studied

Each dot represents one farm. No farms in Le Sueur and Mower counties were included in 1928, 1929, and 1930, and only a few in Goodhue County.

[2] The authors wish to acknowledge their indebtedness to the farmers who co-operated in this study and to R. C. Bevan, who, as fieldman, supervised the records which furnish the basis for this publication.

Each farmer co-operating in this study was supplied with a University of Minnesota farm record and account book in which he entered his entire farm inventory at the beginning and end of each year, all items of cash receipts and cash expenses, the quantities of feed used by each class of livestock, the amounts of farm-raised produce used by the farm family, crop yields, and other miscellaneous information covering the year's business. A field man visited each farmer several times during the year to check his records for accuracy and completeness and to insure uniformity in the valuation of inventory items. He paid special attention to checking the total amounts of feed reported against the total amounts available as indicated by inventories, yields, sales, and purchases, and made adjustments where necessary in order to insure substantially accurate records of feed for each class of livestock. In addition, he collected considerable supplementary information covering crop and livestock practices. At the end of the year, each farmer was again visited and the entire record carefully checked. The books were then brought to the University and rechecked. Any discrepancies discovered were referred back to the farmer for correction. The quantities of products sold, as well as the quantities of the major items of purchase, were secured in addition to the cash amounts for these items. This system of supervision and checking resulted in a high degree of accuracy in the individual records and in the securing of much detailed data that would not ordinarily be found in the usual farm account book record.

The farms included in this study are all dairy farms of a type characteristic of this section of the state. It is only reasonable to assume, however, that these men are securing higher earnings than the average of all dairy farmers in the area and are probably following more of the good farming practices. In general, it is the better farmers who are interested in keeping farm accounts. In 1931 and 1932, these men paid a fee for the service they received from the farm management workers in charge of the project in the analysis and interpretation of their records. This indicates rather definitely a more than ordinary interest in the business side of farming. Altho the earnings of these men may not be representative of the area, this fact does not detract from the usefulness of their farm records for the purposes of this study. A sufficiently wide range in practices and earnings occurred so that these records serve as well as would the same number of records from a random sample of farmers in the same area.

DESCRIPTION OF AREA

Type of Farming

The eight counties in which the farms included in this study are located represent one of the most intensive areas of dairy production in the state.[3] According to the 1930 federal census,[4] 49 per cent of all farms in these counties other than abnormal and unclassified farms are classed as dairy farms. In addition to these, 30 per cent are classed as general farms and 11 per cent as animal specialty farms. On most of the farms in the two latter classes dairying is the dominant enterprise. In 1929, 57 per cent of the cash income from the dairy farms in these counties was derived from the sales of livestock products, 34 per cent from the sales of livestock, and 9 per cent from the sales of crops.

Dairy products make up the major portion of the livestock product sales. Hogs are second to dairy cattle as a source of income, and poultry and eggs are third. Cream for manufacture into butter is the principal dairy product sold. It is marketed almost exclusively through well-established co-operative creameries specializing in the manufacture of high-grade butter. Of the total receipts from the sales of dairy products in these eight counties in 1929, 82 per cent was from the sales of cream for manufacture into butter, 1 per cent from cream sold for other purposes, and 17 per cent from the sales of whole milk. In Dodge and Goodhue counties, considerable whole milk is sold to cheese factories. In Rice County, a small condensery takes some whole milk, and in both Rice and Goodhue counties whole milk is shipped through the Twin City Milk Producers' Association to Minneapolis and St. Paul. Local cities also afford a market for whole milk. Ninety-five per cent of all the dairy cows in these eight counties are of the specialized dairy breeds and 5 per cent of dual purpose or beef breeding. Purebred sires are quite generally used and many cows are also purebred. Considerable numbers of breeding stock and milk cows, both purebred and high grade, are sold to dairymen in other sections of the state and in other states.

The proportion of land in each of the principal crops is as follows: corn, 28.8 per cent; oats, 24.4 per cent; tame hay, 16.7 per cent; barley, 10 8 per cent; wild hay, 8.4 per cent; wheat, 6.5 per cent; flax, 2.9 per cent; and rye, 1.5 per cent. Most of these crops are feed crops. The flax and most of the wheat and rye are sold. In addition, sugar beets, potatoes, canning peas, and sweet corn are grown as cash crops on a few farms in these counties.

[3] For a fuller description of the history and development of dairying in southeastern Minnesota, see Minn. Agr. Expt. Sta. Tech. Bul. 44, Dairy Farm Organization in Southeastern Minnesota, by G. A. Pond.

[4] Fifteenth Census of the United States. Agriculture, Minnesota. Statistics by Counties. Third Series. Type of Farm.

Soil and Topography[5]

Farm production and hence farm earnings are influenced by the character of the soil and by topography. These factors are outside the farmer's control but must be considered in any study of variations in earnings among different farms. A generalized picture of the soils and cultural possibilities in these eight counties is shown in Figure 3. In Area 1, the soils are prevailingly black or brown silt loams, clay loams and loams with heavy sub-soils. These soils are naturally better supplied with nitrogen than those of Areas 2, 3, and 4, and the supply of lime is adequate for alfalfa and sweet clover. Phosphate deficiency is common. The topography is undulating to rolling. The natural drainage is usually good, but there are numerous small wet depressions and some extensive flat areas. Some of these have been ditched or tiled, but in some cases the natural water courses are not sufficiently deep to provide an outlet for drainage except at prohibitive expense. Some of these low depressions have peat soils.

In Area 2, the prevailing soils are heavy loams with heavy subsoils. The surface is undulating to gently rolling. Natural drainage in many places is poor, but satisfactory drainage can usually be provided without great cost. Because this is an old formation, natural water courses have been worn more deeply. Practically no peat occurs. The supply of lime is variable, tending to be deficient for alfalfa and sweet clover on the east but toward the west sufficient. The natural supply of nitrogen is less than in Area 1 but a little better than in Area 3. Potash is usually deficient in the poorly drained portions, but the phosphate deficiency appears less common than in Area 1.

The soils in Area 3 are prevailingly silt loams and loams with heavy subsoil. The surface varies from rolling to strongly rolling, with steep hillsides along the Mississippi River and its tributaries. Practically no peat occurs. The natural drainage is good. The natural supply of lime for alfalfa and sweet clover is generally poor in the surface soil, but limestone underlies the entire area. The potash supply is naturally good, that of phosphate variable, while the nitrogen supply is less than in Areas 1 and 2.

The soils in Area 4 are sands or sandy loams that have sandy or gravelly subsoils. They are drouthy soils but have no significance in this study since none of the farms included are in this area. Area 5 consists of large continuous areas of peat bogs. None of the farms studied lie entirely in this area. No soils of Group 6 are found in these eight counties.

[5] The authors are indebted to the Division of Soils of the Minnesota Agricultural Experiment Station for the information on the soils in this section.

In few places in these areas are there sufficient boulders or small stones to interfere seriously with cultivation. The supply of phosphate is variable throughout these counties.

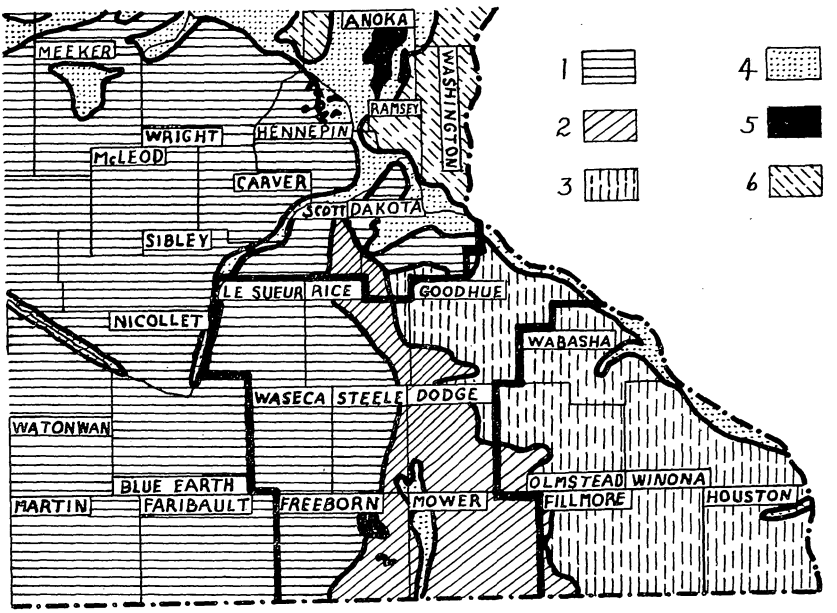

Fig. 3. Map of Broad Soil Groups in Southeastern Minnesota
The soils are classified with respect to productivity and cultural possibilities. A description of each group is presented in the text, pages 10 to 11. (Map presented through the courtesy of the Division of Soils, Minnesota Agricultural Experiment Station.)

The variability in soils and topography are reflected in differences in the selection and yields of crops among these eight counties. The distribution of the crop acreage in each county is shown in Table 2. Only the crops occupying at least one per cent of the entire crop area are shown. The smaller acreage of corn in Goodhue County is the result quite largely of the more rolling topography which results in erosion in case of an inter-tilled crop. The larger acreage of small grain balances up the feed supply and in part reflects the fact that since the soil is better drained it can be worked sufficiently early in the spring to seed small grain at the most favorable time. The larger acreage of flax in Mower and Dodge counties is partly the result of poor drainage. Much of this flax is seeded on land that is too wet early in the spring at the time wheat, oats, and barley are usually seeded. The larger proportion of wild hay in the five western counties is the result of large areas of land too poorly drained for seeded crops.

Table 2

Percentage Distribution of Land Among Principal Crops by Counties for the Five-Year Period 1928-32*

	Le Sueur	Free-born	Waseca	Rice	Steele	Dodge	Mower	Good-hue	Av., 8 counties
Corn	34.6	34.2	32.0	30.1	29.3	27.1	26.4	20.5	28.8
Oats	14.9	27.9	21.7	19.2	24.0	26.0	34.1	20.6	24.4
Barley	3.8	8.0	7.7	11.0	11.8	13.0	8.7	19.9	10.8
Wheat	19.6	2.3	8.9	11.0	4.7	2.1	0.9	8.1	6.5
Rye	0.6	0.9	0.7	1.8	0.7	0.6	0.3	5.0	1.5
Flax	1.3	1.3	1.5	0.8	1.2	5.4	6.3	4.0	2.9
Total grain	40.2	40.4	40.5	43.8	42.4	47.1	50.3	57.6	46.1
Tame hay	8.9	14.9	16.2	9.2	15.6	22.8	21.4	20.5	16.7
Wild hay	16.3	10.4	11.3	16.9	12.7	3.0	1.9	1.4	8.4
Total hay	25.2	25.3	27.5	26.1	28.3	25.8	23.3	21.9	25.1

* Data from Minnesota Annual Crop and Livestock Statistics.

The distribution of land among the different tame hay crops is shown in Table 3 for each county. The smaller proportion of land in alfalfa and clover in Mower and Dodge counties reflects the lime deficiency in the case of the former and the tendency of both these crops to suffer from winter-killing on the flat and poorly drained land.

Table 3

Percentage Distribution of Tame Hay Acreage by Counties in 1929*

	Le Sueur	Free-born	Steele	Rice	Waseca	Good-hue	Mower	Dodge	Av., 8 counties
Timothy and clover	27.5	63.6	61.3	40.4	40.7	74.2	91.3	83.8	70.0
Alfalfa	54.0	25.5	20.3	38.8	35.2	15.6	2.9	4.4	17.7
Clover—red and alsike	16.0	9.8	16.7	19.4	22.8	9.4	5.5	10.9	11.3
Clover—sweet	2.5	1.1	1.6	1.4	1.3	0.8	0.3	0.9	1.0

* Data from the Fifteenth Census of the United States.

The five-year average yield of each of the principal crops in each county is shown in Table 4. The lower hay yields in Mower and Dodge counties are largely the result of the larger proportion of timothy and clover relative to alfalfa and clover as shown in Table 3. Tame hay has not been included in the crop index because of the varying proportions of the different hay crops in different counties. The five western counties have a higher crop index than the eastern counties. The lower index in Waseca County, as compared with the other four, largely reflects poorer drainage. The lower index in Goodhue County is largely the result of the smaller nitrogen supply and that in Mower and Dodge of poorer drainage. The effect of these differences in natural conditions upon farm production can be modified to a certain extent by drainage, good tillage practices, the use of lime, commercial fertilizers and manures, and by the growing of legumes, but they must be recog-

nized as important factors affecting farm earnings. To the extent that they exist, the area studied is not homogeneous and uniform farming systems or practices cannot be recommended.

Table 4

Five-Year Average Crop Yields by Counties, 1928-32*

	Le Sueur	Free-born	Rice	Steele	Waseca	Good-hue	Mower	Dodge
Corn, bu.	44	41	39	40	40	38	34	34
Oats, bu.	44	41	42	41	39	40	38	35
Barley, bu.	32	34	33	32	29	26	26	25
Spring wheat, bu.	18	16	18	18	15	15	16	15
Winter wheat, bu.	23	18	22	21	19	20	17	18
Tame hay, tons	1.8	2.1	2.1	1.8	2.2	1.8	1.4	1.4
Crop index†, per cent...	112.2	105.1	104.9	104.1	99.6	95.5	91.3	87.1

* Data from Minnesota Annual Crop and Livestock Statistics.

† The crop index indicates the relation of the yield of all crops listed above, except tame hay, weighted on the basis of the acreage of each crop, to the average yield of these crops in the eight counties.

Climate

Another important variable affecting farm production is climate. In an area as small as the one included in this study, general climatic conditions are fairly uniform. There is, however, considerable variation in weather from year to year and some variation among different parts of the area within a given year. The normal precipitation and that for each of the years included in this study of the four United States Weather Bureau stations in these counties is shown in Table 5. The location of these stations is shown in Figure 1. The precipitation during the five months when it has the most effect on crop production for the year is also shown. In general, the rainfall increases toward the eastern and southern borders of this area. The average yearly precipitation for the five years was only slightly below normal, but the variations from year to year were not at all uniform among the different weather stations. The rainfall during the growing season varied less than the total for the year. In 1928 the precipitation during the growing season was above normal at all stations, in 1931 it was below normal at all stations, and in 1932 it was below normal at three stations. The deficiency in precipitation in 1931 coupled with high summer temperatures greatly reduced crop yields that year, especially in Goodhue, Rice, Dodge, and Mower counties.

The monthly rainfall for each of the four weather stations each year in comparison with the normal is shown in Figure 4. Monthly deviations from normal at the different stations were uniformly in the same direction in 1928 and fairly so in 1931 and 1932 but were quite variable in both 1929 and 1930. This variability of rainfall among different parts of this area is a factor outside the farmer's control that has an

important effect on crop yields, and to a less extent on farm practices and labor costs. Even within an area as small as this, part of the variation in earnings among farmers will be due to the variability in rainfall within the area, but the importance of this factor varies widely from year to year.

Table 5

Precipitation Reported at Four United States Weather Bureau Stations in Southeastern Minnesota

Period	Year	Albert Lea	Waseca	Zumbrota	Faribault
		inches	inches	inches	inches
Annual	normal*	29.51	28.36	27.69	25.78
	1928	32.85	27.44	28.66	....†
	1929	26.51	27.41	33.05	28.30
	1930	34.44	34.55	26.39	17.30
	1931	25.39	28.21	29.44	26.12
	1932	23.46	22.72	21.76	25.46
April to August, inclusive	normal*	18.27	18.01	16.50	16.22
	1928	23.41	20.65	20.12	....†
	1929	16.38	15 99	18.67	16.60
	1930	21.67	25.31	15.51	11.55
	1931	11.32	14.00	14.94	13.23
	1932	16.01	14.26	13.52	19.73

* The number of years upon which the normal is based is as follows: Albert Lea, 42; Faribault, 35; Waseca, 18; and Zumbrota, 37.
† Data incomplete.

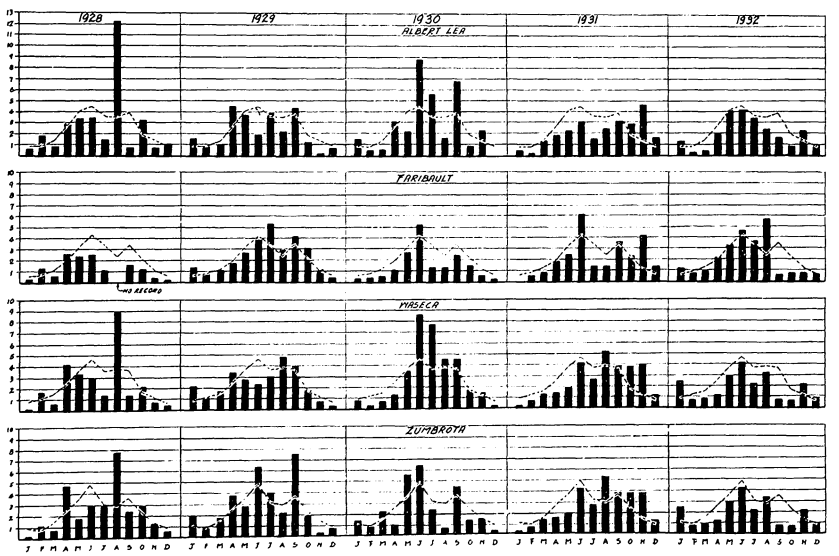

Fig. 4. Precipitation by Months Compared with Normal for Four Weather Stations in Southeastern Minnesota, 1928-32

The normal seasonal distribution of rainfall, as shown by the dotted line, is quite similar for each of these four stations. The variations from normal are not at all uniform among these stations. This results in considerable variation in crop yields among the eight counties included in this study.

Some data covering the normal temperatures within these eight counties and the deviations from normal for the years of this study are shown in Table 6. Unlike rainfall, temperatures did not vary materially among the different weather stations. Altho the temperature for a given month may have varied widely from the normal for the month it seldom varied as much as two degrees among the four stations. For this reason, only an average of the temperatures reported by these four stations is given. The years 1928, 1929, and 1930 did not vary widely from the normal during the crop season altho during the months April to August, inclusive, in 1930 the temperatures were slightly above normal. The year 1931 was one of the warmest on record in this section of the state. In every month except May the temperatures exceeded the normal, and the high June and July temperatures coupled with subnormal precipitation greatly reduced crop yields. Summer temperatures in 1932 were also considerably above normal. Since temperature is comparatively uniform throughout the area, it is very largely a constant factor affecting all farms much the same. Hence it does not tend to obscure the results of a study of management factors affecting earnings as does rainfall which may vary among farms or even on different parts of the same farm.

Table 6

Mean Monthly and Annual Normal Temperatures in Southeastern Minnesota and Deviations from the Normal Temperatures for the Years 1928 to 1931*

		Deviations from normal temperature				
	Normal	1928	1929	1930	1931	1932
	degrees	degrees	degrees	degrees	degrees	degrees
January	12.9	+6.5	−10.3	−6.1	+13.0	+4.5
February	17.0	+6.4	−7.8	+11.7	+16.1	+3.9
March	31.0	+3.7	+3.3	+2.8	+1.2	−8.3
April	45.6	−5.5	+2.0	+3.4	+4.4	+1.3
May	57.4	+3.9	−1.9	+0.8	−0.5	+2.3
June	66.3	−3.2	−0.7	+1.1	+7.9	+4.3
July	71.7	+1.4	+1.4	+3.1	+4.0	+2.1
August	69.4	+1.2	+0.9	+3.3	+1.9	+2.3
September	61.3	−1.5	−0.9	+0.5	+8.5	−1.2
October	48.9	+2.4	+0.7	−1.2	+5.4	−2.1
November	32.3	+3.9	−3.4	+5.7	+8.6	−1.1
December	18.8	+7.0	−0.2	+4.0	+11.9	−0.8
Annual	44.5	+2.0	−1.6	+2.3	+6.7	+0.5

* Average of temperatures recorded at United States Weather Bureau stations at Albert Lea, Faribault, Waseca, and Zumbrota.

Description of Farms

The average size of the farms studied was 185 acres and ranged from 40 acres to 680 acres. The average size of all dairy farms in the eight counties as reported in the federal census, weighted by the number of records from each county, was 147 acres. The percentage distribution according to size of the farms studied and of all dairy farms of 20 acres and over in these counties is shown in Table 7. The modal

size group is the same and of about the same relative frequency in both groups, but proportionately more of the farms studied are in the larger groups and less in the smaller ones.

Table 7

Percentage Distribution According to Size of Farms Studied and of all Dairy Farms of 20 Acres and Over in the Same Counties, 1929

Size group	Farms studied	All dairy farms of 20 acres and over*
20- 49 acres	0.4	4.7
50- 99 acres	11.4	21.7
100-174 acres	45.8	47.9
175-259 acres	29.4	18.8
260-499 acres	12.1	6.7
500-999 acres	0.9	0.2

* 1930 United States Census data weighted by the number of records in each county.

Table 8

Utilization of Land on the Farms Studied, 1928-32

Items	1928	1929	1930	1931	1932	Average*
Number of farms	124	172	180	147	143	153
	acres	acres	acres	acres	acres	acres
Oats	11.8	13.6	14.7	15.2	16.5	14.4
Barley	9.9	12.2	10.7	13.2	12.0	11.6
Winter wheat	1.3	2.9	3.1	3.4	4.0	2.9
Spring wheat	0.4	0.5	0.9	0.7	0.8	0.7
Flax	2.0	1.8	4.2	2.1	1.7	2.4
Rye	0.5	1.0	1.7	1.9	1.5	1.4
Oats and barley	16.2	15.1	18.0	16.0	15.7	16.2
Oats and wheat	5.9	4.2	2.4	4.1	3.8	4.0
Flax and wheat	...	1.7	1.5	2.0	1.8	1.5
Other mixtures	1.7	0.5	0.7	2.5	2.2	1.5
Canning peas	0.1	1.0	1.5	1.1	1.0	1.0
Total grain	49.8	54.5	59.4	62.2	61.0	57.6
Corn for grain	24.1	24.5	27.3	27.4	32.6	27.1
Corn silage	11.7	9.4	10.1	15.3	12.1	11.6
Corn fodder	2.4	2.7	1.5	2.3	1.2	2.0
Sweet corn	0.1	1.8	2.0	1.2	1.7	1.5
Sugar beets	0.2	0.8	0.6	0.4	0.5	0.5
Potatoes	0.6	0.5	0.7	0.9	0.9	0.7
Truck crops	...	0.1	0.1	0.1	0.2	0.1
Total cultivated crops	39.1	39.8	42.3	47.6	49.2	43.5
Alfalfa	6.2	7.6	7.7	8.8	10.6	8.2
Red clover	3.4	4.4	2.1	2.6	1.5	2.8
Legume mixtures	3.4	5.6	6.6	6.2	7.5	5.9
Timothy	0.5	2.2	3.0	2.9	2.7	2.3
Annual hay crop	3.0	0.4	0.3	0.7	0.8	1.0
Wild hay (tillable land)	0.9	1.3	0.4	0.6	..	0.6
Wild hay (non-tillable land)	5.7	5.4	5.5	4.3	4.9	5.2
Total hay	23.1	26.9	25.6	26.1	28.0	26.0
Sweet clover pasture	3.1	3.8	3.6	4.8	5.3	4.1
Other legume pasture	1.7	3.3	3.7	5.4	2.5	3.7
Other tillable pasture	13.6	11.5	10.0	8.3	10.4	10.7
Non-tillable pasture	19.7	22.7	23.4	26.1	25.5	23.5
Total pasture	38.1	41.3	40.7	44.6	45.2	42.0
Summer fallow	0.1	0.3	0.7	0.7	0.6	0.5
Timber, not pasture	2.5	2.0	2.4	5.4	5.7	3.6
Roads and waste	4.7	5.9	6.3	5.5	5.8	5.7
Farmstead	5.9	5.7	5.8	6.3	5.9	5.9
Total acres in farm	163.3	176.4	183.2	198.4	201.4	184.8
Per cent of land in harvested crops	68.6	74.2	69.5	68.5	68.6	68.8
Per cent of land tillable	76.4	76.4	76.3	76.0	76.0	76.3

*Weighted by number of farms each year.

The utilization of land on these farms is shown in Table 8 for each of the five years. Altho there was some change in the farms included from year to year, the proportionate distribution of the acreage among the different groups of crops was quite uniform throughout the period. The farms added each year were larger than those dropped, but an increase in size was not accompanied by any material change in the utilization of the land. The five-year average proportion of land in harvested crops was 68.8 per cent on the farms studied as compared with 64.3 per cent on all dairy farms in these counties in 1929 as reported in the federal census. The proportion of land in pasture was practically the same for both groups. A comparison between the use of land on these farms and on all farms in these eight counties is shown in Table 9. The farms studied differ little from the average of the area in the proportion of land in cultivated crops, but have relatively more small grain. The proportion of land in hay is smaller, but 77 per cent of this is tame hay compared with 68 per cent for these counties as a whole. About a third larger proportion of the pasture is on tillable land. The large production of tame hay and tillable pasture offsets in part the smaller acreage.

Table 9

Percentage Distribution of the Use of Land on the Farms Studied and on all Farms in the Same Counties, 1928-32

Use of land	Farms studied						Average of all farms in 8 counties*
	1928	1929	1930	1931	1932	Weighted average	
Grain crops†	30.5	30.9	32.4	31.4	30.3	31.2	23.0
Cultivated crops	23.9	22.6	23.0	24.0	24.4	23.5	24.7
Hay crops	14.1	15.2	14.0	13.2	13.9	14.1	20.2
Pasture	23.3	23.4	22.2	22.5	22.4	22.7	26.7
Other	8.2	7.9	8.4	8.9	9.0	8.5	5.4
Total	100.0	100.0	100.0	100.0	100.0	100.0	100.0

* Data from Minnesota Annual Crop and Livestock Statistics weighted by number of records in each county.

† The grain crops include those listed under this heading in Table 8.

Table 10

Average Yields of Crops on the Farms Studied and on all Farms in the Same Counties, 1928-32

Crops	All farms in 8 counties*	Farms studied	Relation of yield on farms studied to all farms
	bu.	bu.	per cent
Corn	38.8	44.0	113
Oats	40.0	47.3	118
Barley	29.6	32.5	110
Winter wheat	19.8	21.6	109
Spring wheat	16.4	18.8	115
Rye	18.4	18.3	99
Flax	9.8	9.2	94

* Data from Minnesota Crop and Livestock Statistics weighted by number of records in each county.

The farms included in this study do not differ materially in the choice of crops from the other farms in the counties in which they are located. They do, however, differ in yields. This is indicated in Table 10. The yields of all the grain crops are equal to or exceed the county averages, with the exception of rye and flax. This bears out the previous statement that the farms studied were more effectively operated than the average farm of the area.

The amount and kind of livestock maintained on the farms studied is shown in Table 11. All classes of productive livestock except hogs were increased during the five years of the study. The increase in size of farms studied each year accounts for only part of this. Hog production was sharply curtailed in 1932 because of the low price prevailing in 1931 and in part because lower corn yields made less feed available.

Table 11

Kind and Average Amount of Livestock per Farm on the Farms Studied, 1928-32

Kind	Unit	1923	1929	1930	1931	1932	Weighted average*
Cows	head	13.8	14.7	15.5	17.7	18.2	16.0
Other cattle	head	14.2	15.5	16.7	20.3	20.6	17.4
Spring pigs	litters	5.9	6.3	6.8	8.9	7.2	7.0
Fall pigs	litters	3.3	3.2	3.2	5.0	4.0	3.7
Hogs produced	pounds	12,143	13,270	14,974	18,886	14,796	14,851
Sheep	head	6.7	7.3	7.8	12.2	14.4	9.6
Poultry	hens	139	134	147	157	165	148
Work horses	head	5.5	5.4	5.3	5.6	5.4	5.4
Colts	head	0.7	0.8	0.7	0.9	0.8	0.8

* Weighted by number of records each year.

Table 12

Number of Livestock per 100 Acres on Farms Studied Compared with Average Numbers in Same Counties, 1928-32

	Horses and mules	Milk cows	Other cattle	Hogs	Sheep	Poultry
Farms studied	3.7	9.8	10.6	23.6	4.9	125
All farms in same counties*	3.2	8.0	6.1	18.1	2.1	82

* Data from Minnesota Annual Crop and Livestock Statistics, except poultry figures which are taken from the 1930 United States Census and cover only the census year 1930, weighted by the number of records in each county.

A comparison between the amount of stock per 100 acres on the farms studied and that on all farms in the eight counties in which they are located is shown in Table 12. The farms studied are more heavily stocked than other farms in these counties. Higher crop yields and large purchases of feed make it possible for these farmers to carry more stock. The average feed purchase in 1929 was $2.11 per acre as compared with $0.65 for all farms in these eight counties reporting this item in the federal census for that year. More young cattle in

proportion to milk cows are maintained on the farms studied. These represent largely breeding stock being raised for sale.

A comparison between the amount and distribution of the capital investment per acre on the farms studied and for all farms in the counties in which these farms are located is shown in Table 13. The investment per acre on the farms from which the records were obtained was higher in case of all items except the dwelling and the work horses than the average for all farms. The higher value of land is justified by the greater productivity. Higher livestock values are the result of greater numbers and to some extent of better quality and breeding. The investment in hogs is not entirely comparable because of the difference in dates between the two sets of data. For most of the items of investment, the percentage distribution is quite similar. Systems of farming are more uniform in the dairy area of southeastern Minnesota than in any other part of the state.

Table 13

Comparison of Capital Investment per Acre on Farms Studied with all Farms in the Same Counties

	180 farms studied in 1930 (average of Jan. 1 and Dec. 31 inventories)		All farms in same counties,* April 1, 1930	
	Value	Percentage	Value	Percentage
Land	$70.55	51.6	$58.96	52.0
Dwelling	13.54	9.9	14.31	12.6
Farm improvements	22.40	16.4	17.87	15.8
Farm implements and machinery	10.73	7.8	7.86	6.9
Horses and colts	2.75	2.0	2.82	2.5
All cattle	12.86	9.4	8.47	7.5
Hogs	2.62	1.9	2.22	1.9
Sheep	0.42	0.3	0.19	0.2
Poultry	0.91	0.7	0.64	0.6
Total	$136.78	100.0	$113.34	100.0

* United States Census data weighted by number of records in each county.

VARIATIONS IN EARNINGS

Variations in Income and Expenses from Year to Year

The measure of earnings used in this study is "operator's labor earnings."[6] The income and expense used in computing this measure are presented in Tables 14 and 15. These are shown both on a per farm and a per acre basis. They are shown on an acre basis in order to eliminate the effect of differences in size of farms from year to year. The cash receipts and expenses are shown separately from the non-cash or indirect items. Income was much more variable than expense. The range in income among the five yearly averages was 52 per cent of

[6] See appendix, page 77, for an explanation of the method used in computing "operator's labor earnings."

the five-year average income, whereas the corresponding range in expenses was less than 22 per cent of the five-year average expense.

Table 14
Average Income per Farm and per Acre, 1928-32

Item	1928	1929	1930	1931	1932	Five-year average
Cash receipts:						
Dairy products	$1,649	$1,674	$1,374	$1,276	$ 978	$1,390
Cows	353	350	281	174	125	257
Other cattle	375	427	319	286	213	324
Hogs	1,040	1,287	1,323	1,024	502	1,035
Sheep	45	59	35	46	37	44
Poultry	142	138	135	143	140	140
Eggs	272	278	272	231	193	249
Crops	349	525	406	308	288	375
Income from labor off farm	117	87	89	140	106	108
Miscellaneous	114	204	215	161	169	173
Total cash receipts	$4,456	$5,029	$4,449	$3,789	$2,751	$4,095
Increase of farm inventory	387	847	....	....	....	....
Value of farm produce used in house	323	326	304	242	198	278
Total income	$5,166	$6,202	$4,753	$4,031	$2,949	$4,373
Income per acre	$32.25	$35.16	$25.94	$20.32	$14.64	$25.66

Table 15
Average Expense per Farm and per Acre, 1928-32

Item	1928	1929	1930	1931	1932	Five-year average
Cash expense:						
Machinery and power	$ 521	$ 799	$ 653	$ 539	$ 394	$ 581
Buildings, fences and tiling	148	216	210	106	66	149
Hired labor	252	293	262	275	220	260
Feed purchases	504	376	309	380	282	370
Livestock purchases	295	316	324	212	151	260
Other livestock expense	59	74	80	82	55	70
Crop expense*	164	185	175	185	129	168
Taxes and insurance	285	312	324	349	341	322
Miscellaneous	30	29	26	34	31	30
Total cash expense	$2,258	$2,600	$2,363	$2,162	$1,669	$2,210
Decrease in inventory	....	....	375	971	919	206
Board of hired labor	95	110	113	100	68	97
Unpaid family labor	354	361	381	267	229	318
Interest charge at 5 per cent	1,199	1,298	1,310	1,181	861	1,170
Total expense	$3,906	$4,369	$4,542	$4,681	$3,746	$4,001
Expense per acre	$23.92	$24.77	$24.79	$23.59	$18.60	$23.13

* Includes expenditures for seed, twine, threshing, spray materials, etc.

Table 16
Average Prices Received for Products Sold, 1928-32

Unit	1928	1929	1930	1931	1932	Five-year average
Butterfat, pound	$0.53	$0.50	$0.40	$0.29	$0.22	$0.39
Hogs, 100 pounds	8.23	9.60	8.94	5.33	3.18	7.06
Lambs, head	10.02	9.55	5.92	4.36	3.63	6.70
Wool, pound	0.42	0.30	0.18	0.13	0.08	0.22
Eggs, dozen	0.27	0.28	0.22	0.16	0.13	0.21

Income varies with the price received. In the case of these farms, the latter was the more important cause in the variations in the average income from year to year. The average price received each year for

several of the products sold from these farms is shown in Table 16. Variations in income from farm to farm within a given year are more largely affected by quantities sold since prices received by farmers in this area were fairly uniform except for variations in the time of sale.

Another important variable that affects income and expense is change in inventory values. Insofar as possible changes in price levels have been eliminated from the inventory differences shown except those for feed and market stock. Real estate, machinery, and breeding stock were inventoried on the basis of the same prices at the beginning and end of each year. Some adjustments in the 1928 values of real estate and breeding stock in line with current market values were made in 1931 and 1932 but these are not reflected in the annual inventory differences shown.

Variations in Average Earnings from Year to Year

The average operator's labor earnings per farm and per acre for each of the five years are shown in Table 17. A wide range in average earnings from year to year results from the range in receipts and expenses already shown.

Table 17

Average Operator's Labor Earnings per Farm and per Acre 1928-32

	1928	1929	1930	1931	1932	Five-year average
Total farm income	$5,166	$6,202	$4,753	$4,031	$2,949	$4,373
Total farm expense	3,906	4,369	4,542	4,681	3,746	4,001
Operator's labor earnings, total	$1,260	$1,833	$ 211	—$650*	—$797*	$ 372
Operator's labor earnings, per acre	7.72	10.39	1.15	—3.28*	—3.96*	2.40

* Minus sign (—) indicates expense in excess of income.

Variations in Earnings of Identical Farms from Year to Year

There is a considerable variation in the earnings of an individual farmer from year to year. This is indicated in Figure 5. Thirty-five farmers were included in this study for the entire five-year period. The farms in this graph are arrayed according to the average operator's labor earnings for the five years. Then they are ranked from 1 to 35 each year. These data indicate that the earnings of any individual farm for one year do not necessarily indicate the relative profitability of that farm over a period of years. This is especially true during a period of widely fluctuating prices such as the five years covered by this study. The prices of most commodities rose from January 1, 1928 to January 1, 1929, and then declined steadily during the rest of the period. Since there was considerable variation in the relative numbers and kinds of livestock between different farms and similar variation in feeds and

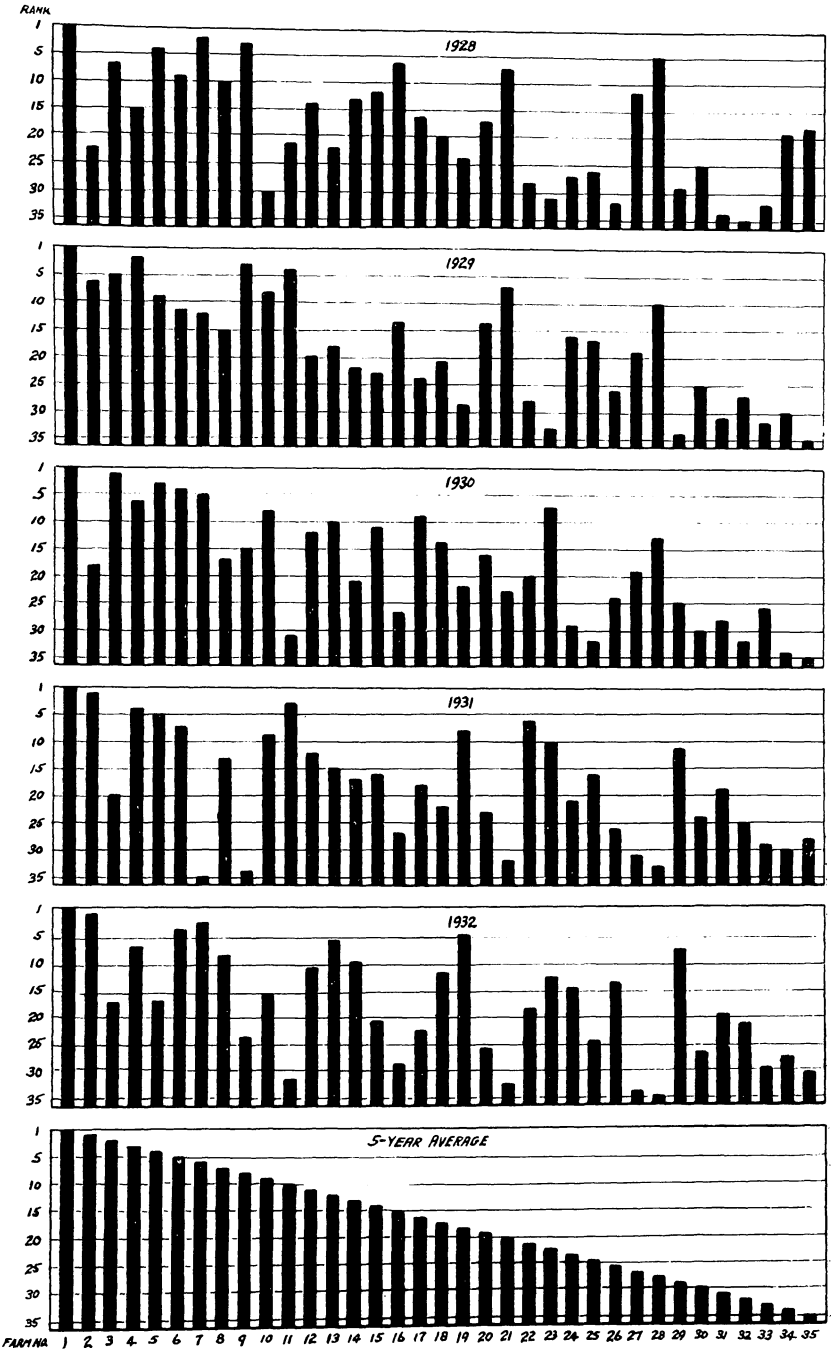

Fig. 5. Ranked Array of the Average Operator's Labor Earnings of 35 Farmers for Five Years and the Individual Rank of Each Farmer Each Year, 1928-32

Each bar represents the relative rank in earnings for a particular farm. The average rank for the five-year period for each farm is shown at the bottom of the diagram and the ranking for each individual year for that farm directly above in a vertical line.

supplies on hand at inventory time, price changes were reflected differently in inventory valuations and hence in earnings. There was also a wide variation in the price changes among different commodities that resulted in variations in income, due to the differences in the combination of enterprises between different farms.

Even with fairly stable price conditions there is normally a considerable shifting from year to year in the position of an individual farm in a group ranked according to earnings. Weather conditions vary between different counties and even within a county. Given weather conditions may affect the production and hence the earnings of various farms very differently. This is due to differences in soil type, in condition of the soil resulting from tillage methods and cropping practices in crop selection, and in other factors that may or may not be within the control of the farm operator. Then, too, insects and disease may affect crop and livestock production on various farms in a given locality very differently. In spite of these factors, however, certain farmers over a period of years obtain consistently high average earnings whereas others are consistently low in earnings. Still others vary widely in relative ranking in earnings from year to year.

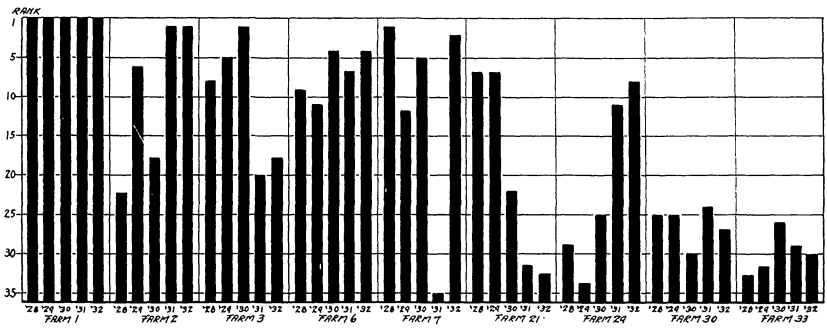

Fig. 6. Year-to-Year Changes in the Rank of Individual Farms in Operator's Labor Earnings
The nine farms shown in this graph were taken from the group of 35 shown in Fig. 5. The reasons for variations in rank of earnings of the same farm between different years are discussed in the text.

Nine farms have been selected from the group of 35 for which five-year records are available to illustrate the extent of year-to-year variation in the relative ranking of an individual farm and the effect of some of the factors just mentioned in causing these variations. These changes in ranking from year to year of the nine farms are presented separately from the rest of the group in Figure 6. Farms 1 and 6 showed consistently high earnings each year, whereas earnings were consistently low on Farms 30 and 33. In these four cases, a fairly uniform system of farming was followed each of the five years.

The differences in earnings between these two pairs of farms was largely the result of differences in size, organization, and efficiency in production.

The remaining five farms varied widely in rank in earnings from year to year. The organization of Farm No. 2, unlike the four just mentioned, was changed very materially during the five years in an effort to adjust it to changing conditions. In 1928 the crops were largely feeding crops. Only 11 per cent of the tillable land was in cash crops. By 1931, 53 per cent of the crop land was in such specialized cash crops as sugar beets and canning peas and corn. There was also a marked shift in livestock. Hog production was reduced 80 per cent and the poultry flock increased to four times the number in 1928. The low earnings in 1928 were due not only to the crop and livestock organization which was in operation at the time but also to low crop yields on a portion of the farm. Eighty acres of land badly infested with weeds and in poor physical condition was purchased in 1927. The operator devoted his attention in 1928 to cleaning this land and putting it in good physical condition at the sacrifice of a full crop. In 1929 exceptionally high yields as well as sales of small grain for seed at much higher than market price raised the earnings. Low yields of crops in 1930 due to a late spring frost and hail damage reduced the earnings in 1930. The general upward trend of earnings is due principally to definite changes in the farm organization.

The lower ranking of Farm 3 in 1931 and 1932 was due principally to the fact that the sales of purebred cattle and of hogs were much more important as sources of income on this farm than on the others. The prices of both cattle and hogs dropped much more relatively than those of other products and this contributed both to a decline in income and to inventory losses. Much lower relative crop yields in 1931, due to drouth, also contributed to the reduced earnings that year. There was little change in the organization of this farm during the five-year period.

Earnings ranked high on Farm 7 except in 1931. The heavy loss that year was due largely to a crop failure caused by drouth and hail and some unusual death loss of livestock. There was little change in the organization of Farm 21 during the five years, but earnings dropped sharply in 1930, 1931 and 1932. Hogs and seed grain were two very important sources of income on this farm. The prices of both declined sharply during the later years. Since the seed grain was usually not sold till the following spring, it was on hand at inventory time and the declining price resulted in heavy inventory losses.

The earnings of Farm 29 showed a steady upward trend in rank. It was a small farm with insufficient volume of business to show large earnings in years of relatively favorable prices. This small business

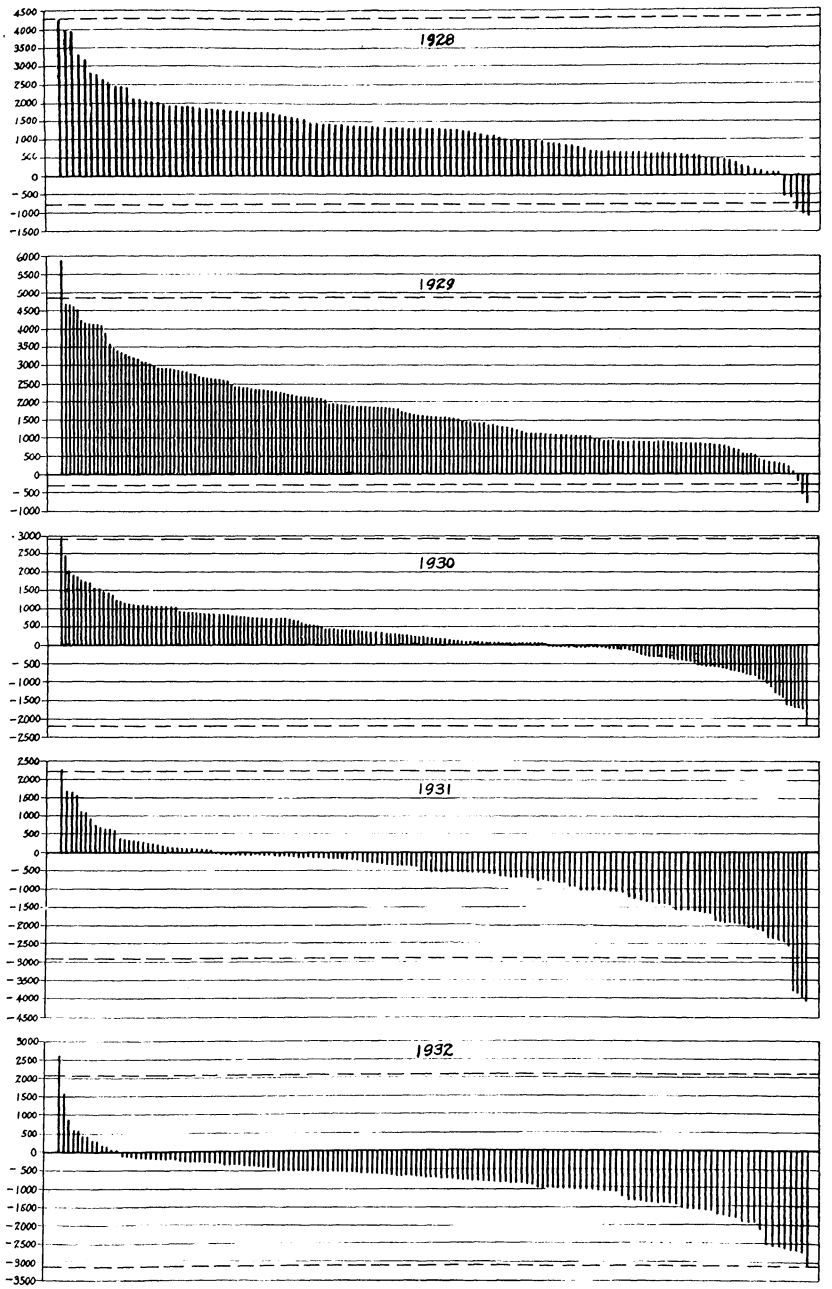

Fig. 7. Range in Operator's Labor Earnings by Years, 1928-32

Each line represents the earnings of one farm. The level of earnings varied widely from year to year, but the range remained remarkably constant. Ninety-eight and one-half per cent of the farms fell within a range of $5,172 each year. The extremes of this range are shown each year by the dotted lines at top and bottom of each section of the chart.

proved an advantage when prices declined sharply since heavy inventory losses, such as those incurred by large farms, were avoided. Furthermore, during the last two years the operator developed a retail market for a larger proportion of his production and also supplemented his farm earnings with outside work. Altho this farm advanced in rank of earnings during the later years, the actual earnings declined each year. The fact that they did not decline as rapidly as those of other farms resulted in an increase in relative rank.

Range in Earnings Among Farms

A wide range in operator's labor earnings among different farms occurred each year. This range, as shown in Table 18, varied from $5,172 to $6,670. The range among individual farms each year is shown graphically in Figure 7. There was a range of more than $5,000 between the highest and lowest earnings each of the five years. This wide range occurred both in the relatively favorable years of 1928 and 1929 and in 1931 and 1932 when most of the farmers had insufficient income to cover all expenses charged against their business. A major objective in this study is to find in the organization and operation of these farms the principal factors causing this variation.

Table 18

Highest, Average, and Lowest Operator's Earnings and Range of Earnings, 1928-32

	1928	1929	1930	1931	1932
Highest	$4,314	$5,898	$2,950	$2,287	$2,595
Average	1,260	1,833	211	−650	−797
Lowest	−1,042	−722	−2,222	−4,052	−2,240
Range	5,456	6,670	5,172	6,339	5,706

RELATION OF THE ORGANIZATION AND MANAGEMENT OF FARMS TO THEIR EARNINGS

The major emphasis of the discussion thus far has been on the relationship between the farmer's earnings and the conditions largely outside his control. In this section an analysis of the association between earnings and the elements of the farm business embodied in organization and management practices will be presented. That there is a relationship between the ability of the farm operator as a manager and the earnings he obtains has been demonstrated by a number of studies previously reported. But the farmer's problem as a manager has many phases, each of which involves adjustments in several directions. And the relative importance of the different phases in their influence on earnings differs as widely as do the conditions under which

the farming operations are conducted. Hence each separate farming area presents a new problem in the ascertainment of the association of the several phases of management with earnings.

In the preliminary reports on the accounting study that have been prepared annually,[7] the organization and management of individual farms have been compared with that of groups of farms. The earnings of the farms compared were also indicated. The method used in making the comparisons was to compute index measures of the different phases of the organization and management of each farm. Each phase of organization and management is commonly known as a "factor," and for convenience it will hereafter be referred to as such in this bulletin. Eight primary organization and management factors have been used in the comparisons. These factors are (1) size of business, (2) choice of crops, (3) intensity of livestock production, (4) crop yields, (5) butterfat production per cow, (6) returns over feed from livestock other than cows, (7) productive man work units per man, and (8) power, machinery, and improvement expense per productive man work unit. Some of the primary factors are presented by more than one measure, as, for example, size of business, about which more will be said in the discussion that follows.

Several of the factors are a composite and are measured by index numbers, as, for example, index of crop yields. In most instances, the measures of the composite factors are supplemented by an index of their more important components.

The rest of this bulletin is devoted largely to an analysis of the 766 farm records covering the five-year period, 1928-32, to determine the interrelationships among the eight factors and the relationship between each factor and earnings. For convenience, the factors are grouped into three categories, representing the three main divisions of the farmer's problem as a manager: (1) Size of business, (2) selection and proportionment of the farm enterprises, and (3) production per unit and economy in production.

Size of Business

The size of the productive operations is one of the important factors affecting the earnings of the farmer. A rough and ready generalization might be that the larger the farm business unit, the higher the earnings in a period of favorable physical and economic conditions, but the greater the losses in a period of unfavorable prices or yields.

[7] Mimeographed Reports 26, 27, 28, 29, and 30, 1928; Mimeographed Reports 35, 36, 37, 38, and 39, 1929; Mimeographed Reports 44, 45, 46, 47, and 48, 1930; Mimeographed Report 52, 1931; and Mimeographed Report 57, 1932, Division of Agricultural Economics, University of Minnesota.

Exceptions to this general statement will be pointed out in the course of the discussion.

Measure of size.—The size of the farm business is usually thought of in terms of area, either total acres in the farm or crop acres. Number of acres is a satisfactory measure of the size of the business unit where the soil and type of farming is uniform among the farms compared. To be strictly comparable on this basis, farms of different sizes that are uniform in soil type should have under cultivation about the same proportions of their areas and have the crop areas divided among the different crops in approximately the same proportions. Moreover, the methods of disposing of the crops should be similar on the different farms. Otherwise, it is obvious that all land is not equally useful and that some uses have different demands for labor and equipment per acre than others.

Farm capital investment accounts, generally speaking, for variation in the usefulness of land, but it does not account for variation in the system of farming and the consequent variation in the use of labor.

The selection of crops on farms in southeastern Minnesota varies from combinations with small grains that use relatively small amounts of labor per acre as the principal crops to combinations in which such crops as canning crops and sugar beets are the leading crops. But a more important source of the inadequacy of number of acres as a measure of size of operations is the variation in the intensity of stocking with livestock. Farms vary in the number of productive animal units[8] associated with each 100 acres. They vary also in the proportions of the livestock units that are relatively heavy users of labor, as, for example, dairy cows and poultry. In other words, farmers secure size of business in ways other than through the addition of acres of land to the farm. In general, production is more intensive in its relation to land on the farms of a small number of acres than it is on the farms including a relatively large number of acres.

The relationship between the number of acres in the farm and the intensity of the use of land is shown in Table 19. There was an inverse relationship between the number of acres in the farm and the amount of productive work per 100 acres or per $1,000 invested. The extent to which the heavier application of labor to land on farms relatively small in number of acres was the result of crop selection is indicated in Table 19 in the column showing the number of productive man work units on crops per 100 acres in crops. The extent to which it was the result of heavier stocking with livestock is indicated in the

[8] The measures of organization and management factors are defined and a method of their computation is outlined in the appendix to this bulletin. It is recommended that the reader study the appendix carefully before reading the rest of the bulletin as separate reference will not be made for each term.

column showing the number of productive animal units per 100 acres. The influence of variation in the combinations of livestock is indicated in the column showing the number of productive man work units per animal unit. The operators of farms relatively small in number of acres not only associated more units of livestock with each acre of land and produced crops and kinds of livestock that used more labor per acre of land, but they secured higher production per unit as indicated by the columns in Table 19 showing index of crop yields and butterfat per cow.

Table 19

Relation of Acres in Farm to Intensity of Use of Land, 1928-32

Acres in farm	No. of farms in group	Productive Man Work Units		
		Per farm	Per 100 acres in farm	Per $1,000 invested
89 and less	70	358	478	31
90-139	137	500	439	31
140-189	255	590	371	28
190-239	139	763	372	29
240-289	83	868	344	28
290-339	42	1,008	321	29
340 and more	40	1,318	306	26

	Productive Man Work Units		Productive animal units per 100 acres	Index of crop yields, per cent	Butterfat per cow, lb.
	On crops per 100 acres in crops	On livestock per animal unit			
89 and less	158	13.8	23.6	102	251
90-139	153	13.2	22.9	104	264
140-189	146	13.1	19.7	99	235
190-239	148	13.8	19.2	98	244
240-289	138	12.2	17.2	98	237
290-339	149	12.2	17.6	95	222
340 and more	139	11.6	16.1	94	225

Under such conditions, the units of labor utilized annually on the different farms in growing crops and caring for livestock are a more satisfactory measure of the size of productive operations than is the number of acres in the different farms. Hence, for the purpose of analyzing the association between size of business and earnings of the different farms, the number of productive man work units is used as a primary measure of size. The relationship between acres in the farms and earnings is shown for comparison.

Before taking up the analysis of the association between size of business and operator's earnings, however, the extent of the variation in size and the differences in the organization and management of groups of farms differing in number of productive man work units will be indicated. The differences in the principal organization and management factors among groups of farms differing in acres operated are set forth in Table 19.

Variation in size of business.—The number of productive man work units performed on the different farms ranged from 150 on the farm with the smallest amount of productive work performed to 2,313 on the farm with the largest amount. The distribution of farms according to size of business as measured by productive man work units is shown in Figure 8. On approximately 50 per cent of the farms, the number of productive man work units ranged from 400 to 699. A wider range of from 300 to 799 productive units included approximately 75 per cent of the farms.

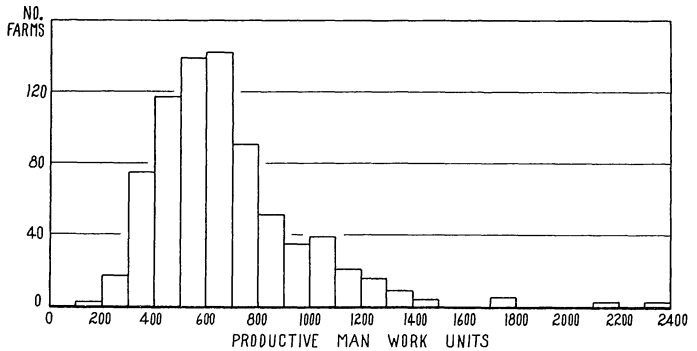

Fig. 8. Distribution of Farms Classified According to Number of Productive Man Work Units
A range of from 300 to 799 in productive man work units included approximately 75 per cent of the farms. On the basis of average performance, this range would be equivalent to the productive employment of from 1 to 2.3 workers.

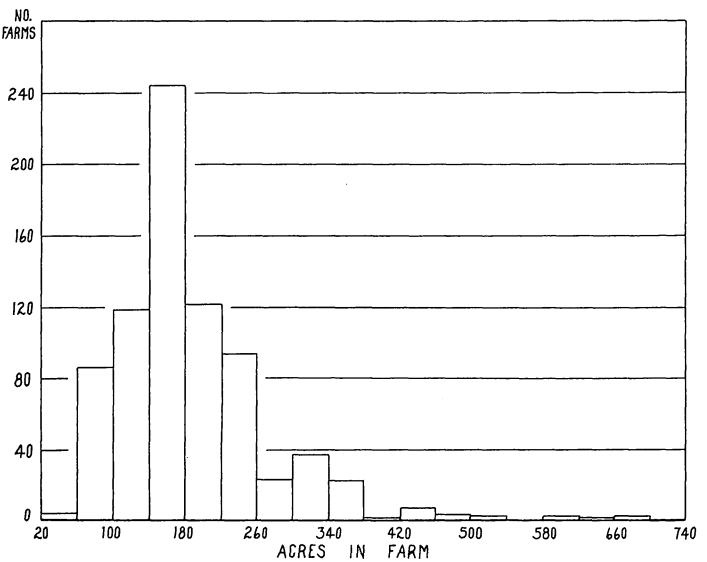

Fig. 9. Distribution of Farms Classified According to Acres in Farm
Thirty-two per cent of the farms included approximately 160 acres. Only 14 per cent exceeded approximately 240 acres.

The variation in size as represented by acres in the farm is shown in Figure 9. The range in numbers of acres operated was from 40 to 680. Thirty-two per cent of the farms included approximately 160 acres. Only 14 per cent of the farms exceeded approximately 240 acres in size.

Relation of number of productive man work units to other factors of organization and management.—In Table 20 is shown the relationship between the number of productive man work units and several other measures of size of business. The relationship between productive man work units and number of workers, acres in the farm, crop area, investment in real estate and working capital invested is direct in each instance.

Table 20

Relation of Productive Man Work Units to Other Measures of Size of Business, 1928-32

Productive man work units	No. of farms in group	Average productive man work units	No. of farm workers	Size of farm, acres	Crop area, acres	Investment in real estate	Working capital investment
349 and less	44	292	1.3	90	59	$ 8,821	$ 3,248
350- 499	167	432	1.6	122	83	11,257	4,628
500- 649	227	578	1.9	164	113	14,871	6,268
650- 799	144	719	2.2	199	138	17,452	7,514
800- 949	73	868	2.4	235	163	21,970	9,025
950-1,099	51	1,029	2.6	256	174	22,520	10,200
1,100 and more.....	60	1,350	3.4	352	247	30,015	13,460

The relationship of the size of the farm business to its organization on southeastern Minnesota dairy farms is indicated in Table 21. As the amount of productive work on farms increased, the proportion that was performed by the proprietor decreased with a corresponding increase in the proportion that was performed by hired labor. The proportion of the work that was performed by family workers was about the same in all groups. The amount of work performed by family workers was greatest on the large farms. The size of the business unit did not materially affect the distribution of the work between crops and livestock. Approximately 27 per cent of the labor was expended on crops and 67 per cent on livestock on farms in each group. In the groups of smallest farms and the two groups of large farms a higher proportion of the productive work was work off the farm for pay than it was in the other groups (see Table 21). The farmers on the small farms no doubt had some spare time for working off the farm, whereas the farmers with the large business units used their equipment such as threshers, tractors, and ensilage cutters, in doing custom work for their neighbors.

Invested capital, particularly land, was used more intensively on the farms on which relatively larger amounts of work were performed. The more intensive use of land was partly the result of the selection of crops that used more labor per acre and partly the result of keeping

Table 21

Relation of Productive Man Work Units to Specified Organization Factors, 1928-32

Productive man work units	No. of farms in group	Percentage of labor by			Percentage productive man work units on			P.M.W.U.* per 100 acres in farm	P.M.W.U.* per $1,000 invested
		Proprietor	Family	Hired	Crops	Livestock	Labor off the farm		
349 and less	44	76.4	17.2	6.4	29.8	62.7	7.5	325	24
350- 499	167	65.7	23.5	10.8	27.5	67.6	4.9	354	27
500- 649	227	58.6	19.5	21.9	28.0	68.0	4.0	352	28
650- 799	144	53.1	17.0	29.9	27.8	68.7	3.5	361	29
800- 949	73	49.3	17.8	32.9	27.5	68.4	4.1	369	28
950-1,099	51	40.8	21.7	37.5	26.3	65.0	8.7	402	31
1,100 and more	60	42.4	21.4	36.2	27.7	62.5	9.8	384	31

	Index of crop selection, per cent	P.M.W.U.* on crops per 100 acres in crops	Productive animal units per 100 acres	Percentage of productive animal units that are					P.M.W.U.* on live-stock per animal unit
				Cows	Other cattle	Hogs	Sheep	Poultry	
349 and less	32.5	147	17.2	49.0	23.1	18.3	3.0	6.5	11.8
350- 499	32.7	144	19.9	47.4	24.2	18.8	4.6	5.0	12.0
500- 649	32.5	143	19.6	47.0	24.6	20.5	3.0	4.9	12.3
650- 799	33.2	145	20.1	46.3	25.4	21.3	3.3	3.7	12.3
800- 949	34.7	146	21.3	45.1	26.3	20.5	3.9	4.3	11.9
950-1,099	36.3	156	21.7	44.2	27.9	20.2	2.2	5.5	12.0
1,100 and more	34.1	151	20.9	45.4	30.1	17.8	3.7	3.0	11.5

* Productive man work units.

more animal units per acre. There was very little difference in the selection of livestock on farms of different sizes. The proportions of the animal units that were cows and poultry tended to decrease as the size of the farm increased, whereas the proportion that was cattle other than dairy cows tended to increase. The proportion that was hogs increased as the size of the farm increased until a medium size of farm was reached. Beyond that point, the relative size of the hog enterprise decreased.

The relationship between the size of the business unit, on the one hand, and the productivity per acre or per animal unit and the economy in the use of labor, power, and equipment, on the other hand, is shown in Table 22. Crop yields were slightly higher on the large business units, but production per cow was lower. Size of business had little, if any, influence on livestock returns above feed cost. The large farms had considerable advantage in economy in the use of labor and some advantage in power, machinery, and improvement expense per productive man work unit.

Table 22

Relation of Productive Man Work Units to Specified Efficiency Factors, 1928-32

Productive man work units	No. of farms in group	Index of crop yields, per cent	Butterfat per cow, lb.	Index of R.O.F.C.* from livestock other than cows, per cent	Index of pow., mch., and imp. exp. per P.M.W.U.†, per cent	Productive man work units per worker
349 and less.....	44	94	249	49.4	114	223
350- 499	167	98	253	47.2	104	281
500- 649	227	98	240	48.1	97	312
650- 799	144	99	239	48.2	97	345
800- 949	73	104	238	48.7	103	383
950-1,099	51	108	237	49.5	97	402
1,100 and more.....	60	97	236	44.8	96	417

* Return over feed cost.
† Index of power, machinery and improvement expense per productive man work unit.

With this picture in mind of the differences in organization and management that are most likely to prevail among groups of farms classified according to size of business, we now proceed to an examination of the relationship between size and earnings.

Relation of productive man work units and acres per farm to earnings.—The general statement made at the beginning of this section relative to the relationship between size of business and earnings is well illustrated by classifying the 766 farms into size groups and comparing the earnings of the different groups. Table 23 shows the average operator's labor earnings by years, from 1928 to 1932, of groups of farms classified according to the amount of labor used on the farm during the year, as measured by productive man work units, and according

to acres in the farm. A comparison of the earnings indicates that in 1928 and 1929, before prices received for farm products were lowered by the general economic depression, the farmers who used a relatively large number of productive man work units obtained, on the average, considerably higher earnings than were obtained by those using a smaller number of units. The differences in earnings favorable to the larger operations, as indicated in Table 23, were approximately the same in 1928 and 1929. Farmers conducting medium-sized operations involving from 500 to 799 productive man work units obtained earnings that were approximately $500 greater than the earnings obtained by the farmers conducting a business involving less than 500 productive man work units. The earnings of the large operations, or those providing productive em-

Table 23

Average Operator's Labor Earnings on Farms Classified According to Productive Man Work Units and Acres in Farm, 1928-32

Size of business	1928		1929		1930	
	No. of farms in group	Operator's labor earnings	No. of farms in group	Operator's labor earnings	No. of farms in group	Operator's labor earnings
Productive man work units						
499 and less	45	$ 837	57	$1,292	56	$146
500-799	61	1,277	88	1,884	87	206
800 and more	18	2,256	27	2,809	37	134
Acres in farm						
139 or less	46	1,213	55	1,522	47	313
140-239	62	1,124	86	1,933	94	255
240 and more	16	1,918	31	2,104	39	—204

	1931		1932	
	No. of farms in group	Operator's labor earnings	No. of farms in group	Operator's labor earnings
499 and less	26	—$237	27	—$527
500-799	68	—659	67	—748
800 and more	53	—843	49	—1,014
139 or less	30	—155	29	—319
149-239	78	—586	74	—708
240 and more	39	—1,160	40	—1,309

ployment for 800 or more man work units, were approximately $950 higher than the earnings on the medium-sized farms. In 1930, at the time the effects of the depression were just beginning to be felt, the earnings on the large farms were about the same, on the average, as those on the small farms. In 1931 and 1932, however, when prices for the products sold from the farm were low relative to the prices of the cost elements and when inventory values were depreciating rapidly, the losses in earnings were less with the small units than with the large units. As between the medium-sized farms and the small farms, the deficit differences in 1931 and 1932 that were unfavorable to medium-

sized farms were approximately the same as the positive differences in 1928 and 1929 that were favorable to the medium-sized farms. But the greater losses in 1931 and 1932 on the large business units as compared with the medium-sized ones were only approximately one-fourth the corresponding positive differences in 1928 and 1929 that were favorable to the groups of large farms.

The range in size of operations, as measured by acres in the different farms, was not so great as was the size range measured in productive man work units (see Tables 19 and 20). As pointed out on page 29, many farmers on farms relatively small in number of acres combined more labor with each acre than did those on the larger farms. Hence many of the farmers on small farms were conducting relatively large operations; the operations on some farms relatively large in number of acres were no larger than those on farms of a smaller number of acres. This situation, together with the fact that size in acres is inversely related with productive work units per acre, while size in work units is directly related with work units per acre, resulted in a narrower range in earnings in 1928 and 1929 among the groups of farms classified according to acres than among the groups classified according to productive man work units. On the other hand, it resulted in a wider range in earnings in 1930, 1931, and 1932 among the groups classified according to acres in the farms. The small farms grouped according to acres had higher earnings (1930) or smaller losses (1931 and 1932) than the small farms grouped according to productive man work units, but the reverse was true of the relatively large farms. Thus it appears that a relatively intense use of land was most profitable throughout the period on farms of all sizes. Greater intensity in the use of land on these farms was largely accomplished by increasing livestock production per acre. During most of these five years, the prices of livestock and livestock products were relatively higher than the prices of crops. The larger amount of livestock per acre on the small farms necessitated the purchase of feeds to supplement those grown on the farm. Low feed prices made this more advantageous than would ordinarily be the case. Intensity secured through increased livestock production tended to be relatively profitable. Increased intensity secured through increased applications of labor and capital to crop production might not have shown the same advantage.

The farm operator, in addition to receiving a compensation for his labor, obtains under favorable conditions a margin of earnings from each unit of capital invested in land and equipment and each unit of hired labor over their annual cash or imputed cost. Thus, assuming the margin to be the same with a large volume of business as with a small one, the greater the number of units, that is, the larger the farm business

operated, the higher the labor earnings which include returns to proprietor's labor and management. For many operators the margins would be the same or greater; for others they would be less, depending upon the capacity of the farmer for management. They would be greater for the operators with a relatively large capacity for management because of the economies resulting from a fuller use of labor, power, and equipment on the large farms (as indicated in Tables 21 and 22). Each unit of those productive factors performs more services under skillful management for the following reasons: (1) The large business unit permits the use of more of the operator's time and that of his regular helpers productively; (2) the man on the large farm drives more work animals hitched to larger machinery, and, in addition, he uses his horses a greater number of days during the year; (3) machinery is used more nearly to its capacity, and, furthermore, more labor-saving machinery is purchased, such as tractors, trucks, and harvesters; (4) the buildings of one farmstead serve more acres and more animals.

These opportunities on large farms for greater efficiency in the use of the productive resources are present in years of low returns as well as good, but they are more than offset when the prices for the products sold from the farm suddenly decline as they did in 1930 by losses rather than profits on the productive resources for which there is a cash or imputed charge. For, while income was lowered, the costs represented by such items as hired labor, repairs, interest, and taxes declined proportionately less. On the large farms, the loss on a large number of units absorbed the earnings of the operator's labor more rapidly than on smaller farms having less out-of-pocket expense.

Table 23 indicated only average advantage or disadvantage, depending on price conditions, in earnings resulting from the operation of groups of farms representing progressively larger business units. As among some smaller groups within each size group, the advantage or disadvantage was much less; among others it was greater. If the farms within each size group having a low index of production, the ones having a medium index of production, and the ones having a high index of production are segregated into groups as indicated in Table 24, it is observed that the extent of the advantage the farmers on large farms had over the smaller farmers in 1928 and 1929 depended in a large measure on whether the farms compared were in the low- or high-production groups. The difference in earnings on the small farms and the medium-sized farms was $196 on those farms with a low production index, $730 on those with a medium production index, and $981 on those with a high production index (see Table 24). The corresponding differences in earnings on the medium-sized farms and the large farms was $527, $1,220, and $593. A similar comparison for the period

1930-32 indicates that, whereas the large farms with a low production index were considerably handicapped in earnings as compared with the small farms, the large farms with a high production index had only slightly lower earnings than the small farms with a high production index.

Table 24

Average Operator's Labor Earnings on Farms Classified According to Production Index and Productive Man Work Units, 1928-32

Productive man work units	Production Index					
	56 and less		57—66		67 and more	
	No. of farms in group	Average operator's labor earnings	No. of farms in group	Average operator's labor earnings	No. of farms in group	Average operator's labor earnings
1928-29						
499 and less.....	33	$ 813	36	$1,141	33	$1,315
500-799	57	1,009	59	1,871	33	2,296
800 and more....	13	1,536	20	3,091	12	2,889
1930-32						
499 and less.....	34	—362	40	—246	35	343
500-799	73	—748	103	—275	46	201
800 and more.....	35	—1,368	65	—634	39	32

When the farms were further sorted into groups such that the comparisons in earnings were among size groups homogeneous in intensity of livestock organization (productive animal units per 100 acres) as well as in production per unit, the advantage of size was even less in 1928 and 1929 among the groups of poorly organized and managed farms, but more among the groups of farms high in numbers of productive animal units per 100 acres and crop and livestock yields. For the period 1930-32, such sorting revealed that among the 46 farms high in those respects there were 17 large farms that had earnings that were $145 higher, on the average, than the earnings on the 14 small farms in the group. Hence, under favorable conditions of organization and management, an increase in the size of the farm may be expected to result in increased earnings even in times of depression.

Choice and Combination of Enterprises

Successful organization and management is dependent not only on the number of units of labor, equipment and land employed, but also on their proportional combination. A second phase of the farmer's function as a manager, therefore, is that of selecting and proportioning the enterprises that comprise his farm business in such a manner that the three elements of production are used most advantageously. As explained on pages 10 to 12, soils and topography have considerable influence on the choice of crops in southeastern Minnesota (see Table 2), yet most farms in that section of the state are adapted to the production

of a variety of crops that may be grown in a wide range of proportional combinations. The proportion of the crops selected that is feed crops controls in a large measure the amount of livestock that can be fed per acre on the farm on farm-grown feeds, but there remains considerable opportunity for the exercise of judgment in the matter of livestock production per acre, as most of the feedable crops may either be marketed directly or converted on the farm into livestock products. Further opportunity for the exercise of judgment in the marketing of feed crops lies in the choice of classes of livestock and in the proportions of the available feed that will be marketed through each kind of livestock.

Choice of Crops

Crops differ disproportionately to their production costs in their cash and feeding values yielded per acre. For example, in southeastern Minnesota, corn may be expected to yield approximately twice as many pounds of digestible nutrients per acre as oats. And the yield of alfalfa in pounds of digestible nutrients is considerably higher than that of any of the other roughages. Alfalfa also leads other roughage crops in pounds of protein in 100 pounds of feed. A comparison of the crops commonly grown in the area in yield per acre of total digestible nutrients and digestible protein is shown in Table 25. The comparison indicates the extent to which the amount and quality of feed produced per acre may vary, depending on the selection and proportional acreages of the crops in the cropping systems. Ordinarily feed is produced most cheaply from crops that yield the largest number of pounds of high quality feed. Furthermore, high-yielding crops provide the basis for larger livestock enterprises.

Table 25

Comparison of Southeastern Minnesota Crops in Yield per Acre of Total Digestible Nutrients and Digestible Protein

Crop	Yield,* bu. or tons	Total digestible nutrients, lb.	Digestible protein, lb.
Grains:			
Corn	39.5	1,807	157
Barley	35.0	1,334	151
Oats and barley	40.0	1,213	148
Winter wheat	19.5	926	103
Oats	39.5	890	123
Spring wheat	17.5	831	92
Roughages:			
Alfalfa	2.75	2,806	584
Red clover	2.00	1,984	296
Clover and timothy	1.67	1,642	169
Timothy	1.25	1,224	70
Wild hay	1.20	1,156	72
Corn fodder	2.50	2,404	185
Corn silage	7.50	2,520	179

* 1921-30 average.

Measure of crop selection.—The influence of variation in the combination of crops grown on different farms is rather difficult to measure. Relationships among crops vary in different parts of local areas and from year to year throughout wide areas. Local differences in the yield of one or more crops, resulting from abnormal weather conditions, are the chief cause of the variation in relationships, altho price changes are important in effecting year-to-year changes in the relationships. The method here used for measuring the relative profitableness of different combinations was that of computing an "index of crop selection" for the combination of crops on each farm. Preparatory to computing the index for individual farms, the crops grown on tillable land in the area were classified into four groups (A, B, C, and D) on the basis of a comparison of their respective sale or feeding values yielded per acre, their effects on soil fertility, the extent to which they facilitate the production of another crop, and their unit costs of production. The average yields and the prices of the period 1921-30 were used in setting up the comparisons. Weighting factors proportional to the relative profitableness of the four groups of crops, as indicated by the comparisons, were assigned to the different groups. The crops included in each group, the weighting factors, and the method of computing the index of crop selection of a particular farm are given in the appendix on page 81.

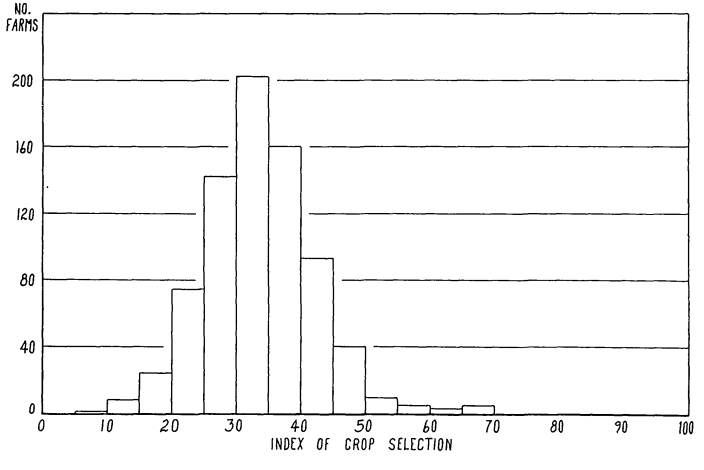

Fig. 10. Distribution of Farms Classified According to Index of Crop Selection
A relatively high index of crop selection was accomplished by growing such crops as alfalfa, sugar beets, canning peas, and corn on a relatively high proportion of the tillable area.

Variation in index of crop selection.—The distribution of farms classified according to their index of crop selection is shown in Figure 10. The range in the index was from 7 to 69. The modal frequency

group included those farms having an index of from 30 to 35. A range of from 25 to 40 included 66 per cent of the farms.

It was said on page 37 that the variation in index of crop selection was the result partly of differences in judgment in the selection of crops and partly of the geographical location of the different farms. The extent to which the index of crop selection of a particular farm reflects its geographical location is shown in Table 26. A comparison of the average index of crop selection on farms in the different counties in 1931 and 1932 indicates the degree of handicap to a better selection of crops experienced by farmers, depending on the location of their farms. It may be said, however, that all differences in the index of crop selection, irrespective of their origin, are much alike in their effects on other parts of the farm organization and the earnings of the farm. It is seldom that low productivity is adequately reflected in the market or rental values of low-yielding farms.

Table 26

Average Index of Crop Selection, by Counties, 1931 and 1932

County	1931		1932	
	No. of farms	Index of crop selection	No. of farms	Index of crop selection
Dodge	17	28.3	15	31.8
Freeborn	26	34.9	24	38.2
Goodhue	33	29.1	31	31.7
Le Sueur	12	36.5	11	36.7
Mower	8	28.5	9	28.2
Rice	22	35.3	22	37.5
Steele	18	36.1	21	37.7
Waseca	11	42.4	10	44.3

Relation of index of crop selection to other organization and management factors.—There was little, if any, association between size of farms in acres and index of crop selection. The farms, however, that were relatively high in index of crop selection were relatively large in productive man work units. The crops that were most profitable, such as alfalfa hay, sugar beets, canning peas, and corn, used relatively large amounts of labor per acre, and corn and alfalfa hay produced relatively large amounts of feed per acre. The heavier production of feed made possible a heavier stocking with livestock per 100 acres. Thus the farmers having a relatively high index of crop selection used a relatively large amount of labor per acre (see Table 27). The relatively large amount of livestock kept on the farms having a high index of crop selection was made possible partly through choosing crops that normally produce more than the average quantity of feed per acre and partly through the higher yields of all crops as a result of the beneficial effects of a relatively high proportion of the land

in legumes on the productivity of the soil. Moreover, it is more than likely that the farmers who arrange profitable combinations of crops are also the ones who may be expected to obtain better than average yields by following other approved practices of good crop management.

Table 27

Relation of Index of Crop Selection to Other Organization and Management Factors, 1928-32

Index of crop selection, per cent	No. of farms in group	Average index of crop selection, per cent	Productive man work units	P.M.W.U.* per 100 acres in farm	P.M.W.U.* on crops per 100 acres in crops
19 and less	33	16	562	334	91
20-25	88	23	664	334	92
26-31	195	29	718	348	97
32-37	242	34	649	361	101
38-43	134	40	644	398	111
44-49	52	46	733	425	118
50 and more	22	58	819	445	123

	Productive animal units per 100 acres	Index of crop yields, per cent	Value of real estate per acre	Butter-fat per cow, lb.	Index of R.O.F.C.† from live-stock other than cows, per cent
19 and less	18	84	$86	245	46
20-25	19	93	88	230	49
26-31	19	95	89	240	46
32-37	20	100	89	243	48
38-43	22	106	89	251	49
44-49	23	110	99	253	51
50 and more	24	109	95	229	47

* Productive man work units.
† Returns over feed cost.

In most of the range in the index of crop selection the progressively higher indexes and the associated higher yields were not accomplished on higher-valued land. It will be observed in Table 27 that among the first four groups of farms there was a range of only $3 in the average value of real estate per acre. The next, or fifth group, averaged $10 higher than the fourth group in value per acre of real estate, but the corresponding average for the sixth group was only $6 higher than that of the fourth group.

There was some tendency for a high index of crop selection to be accompanied by relatively high efficiency in livestock production (see Table 27). There was no consistent relationship between index of crop selection and economy in the use of labor, power, and equipment.

Relation of index of crop selection to earnings.—In Table 28 is shown the average operator's labor earnings by years, from 1928 to 1932, of groups of farms classified according to the index of crop selection. A comparison of the earnings of the different groups indicates that farmers who produced high-return crops on a relatively

large proportion of their tillable acreage obtained higher earnings or smaller losses than their neighbors. The range in difference in earnings among the five groups of farms shown in Table 28 was from $591 in 1928 to $1,495 in 1929. In 1930, 1931, and 1932, the differences were $782, $985, and $817, respectively. The differences in earnings were larger among the groups of farms with a relatively high index than they were among the groups with an index that was below the average. This was particularly true for the years 1930, 1931, and 1932. A high index was accomplished on many farms by the selection of sugar beets and canning crops. The prices of these crops did not decline during the early years of the depression so much as did the feed crops and livestock products.

Table 28

Average Operator's Labor Earnings on Farms Classified According to Index of Crop Selection, 1928-32

Index of crop selection, per cent	1928		1929	
	No. of farms in group	Operator's labor earnings	No. of farms in group	Operator's labor earnings
25 and less	33	$1,057	22	$1,204
26-31	33	1,227	54	1,667
32-37	34	1,282	57	1,827
38-43	17	1,511	25	2,274
44 and more	7	1,648	14	2,699

	1930		1931		1932	
	No. of farms in group	Operator's labor earnings	No. of farms in group	Operator's labor earnings	No. of farms in group	Operator's labor earnings
25 and less	28	$ 19	24	—$791	14	—$959
26-31	47	—22	34	—964	27	—1,031
32-37	58	112	46	—704	47	—896
38-43	29	632	29	—386	34	—769
44 and more	18	759	14	21	21	—214

In Table 28 no account is taken of differences in size of business. Differences in choice of crops were accompanied by greater differences in earnings on the large farms than on the smaller ones. This is indicated in Table 29 in which the farms of different years have been combined and each of the three index-of-crop-selection groups have been further classified on the basis of size of business measured in productive man work units. The differences in adjusted earnings[9] between the high and low index groups on the small farms was $420, as compared with corresponding differences of $601 and $1,226 on the medium-sized and the large farms, respectively.

[9] See appendix, page 78, for an explanation of the method of computing "adjusted operator's labor earnings."

Table 29

Average Adjusted Operator's Labor Earnings on Farms Classified According to Size of Business and Index of Crop Selection, 1928-32

Index of crop selection, per cent	All farms		Productive man work units					
			499 and less		500-799		800 and more	
	No. of farms in group	Adjusted operator's labor earnings	No. of farms in group	Adjusted operator's labor earnings	No. of farms in group	Adjusted operator's labor earnings	No. of farms in group	Adjusted operator's labor earnings
29 and less.....	249	$1,336	73	$ 888	124	$1,299	52	$2,051
30-39	362	1,683	95	1,076	183	1,667	84	2,403
40 and more....	155	2,162	43	1,308	64	1,900	48	3,277

The comparisons in Table 27 indicated that relatively high indexes of crop selection tended to be accompanied by correspondingly high crop yields. If the two factors are generally so associated, the increases in earnings noted in Tables 28 and 29 should be ascribed to them jointly. To determine the extent to which the two factors were associated and to measure the effect on earnings of differences in index of crop selection among farms with approximately the same index of crop yields, the farms were first grouped into three groups on the basis of index of crop yields and then each of the three crop-yield groups was subdivided according to index of crop selection. The distribution of the farms among the groups and the average adjusted earnings of the groups are given in Table 30. The table also shows the number of farms and average earnings of the respective groups classified according to size of farm.

Table 30

Average Adjusted Operator's Labor Earnings on Farms Classified According to Size of Business, Index of Crop Yields, and Index of Crop Selection, 1928-32

Index of crop selection, per cent	All farms		Productive man work units					
			499 and less		500-799		800 and more	
	No. of farms in group	Adjusted operator's labor earnings	No. of farms in group	Adjusted operator's labor earnings	No. of farms in group	Adjusted operator's labor earnings	No. of farms in group	Adjusted operator's labor earnings
Index of crop yields 89 and less								
29 and less.....	114	$1,307	29	$ 936	58	$1,140	27	$2,064
30-39	95	1,306	29	804	51	1,423	15	1,876
40 and more...	21	1,773	4	*	12	1,621	5	*
Index of crop yields 90-109								
29 and less.....	99	1,289	35	854	46	1,351	18	1,974
30-39	160	1,721	45	1,093	81	1,792	34	2,385
40 and more....	57	1,909	19	1,191	20	1,732	18	2,863
Index of crop yields 110 and more								
29 and less....	36	1,557	9	*	20	1,644	7	*
30-39	107	1,951	21	1,417	51	1,712	35	2,647
40 and more....	77	2,455	20	1,404	32	2,109	25	3,740

* The number of farms is not large enough to give a significant average.

The comparisons in Table 30 indicate that in many instances a relatively high index of crop selection is not accompanied by high crop yields. They also indicate that the earnings on farms with relatively high indexes of crop selection were highest in most instances even tho the changes upward were not accompanied by changes upward in crop yields. The notable exception was on farms with low crop yields. It was only among the medium-sized farms that a relatively high index of crop selection resulted in an increase in earnings. As previously stated, a high index of selection is accomplished by growing such crops as the legumes, corn, canning peas, and sugar beets on a high proportion of the tillable area. In general, these crops do relatively better on high-yielding land. Oftentimes the crops that yield a lower net value on the better grades of land have a comparative advantage on the lower grades of land until the productivity of such land has been built up over a period of years.

Farmers with a small volume of business did not secure so large an advantage in earnings through the selection of such cash crops as sugar beets and canning crops as did those with a large volume of business. The farmers with a small volume of business have more use for feed crops as a basis for livestock enterpises.

Intensity of Livestock Production

The principal difference among the farms studied in the selection of livestock was in the amount of livestock kept per 100 acres. Measured

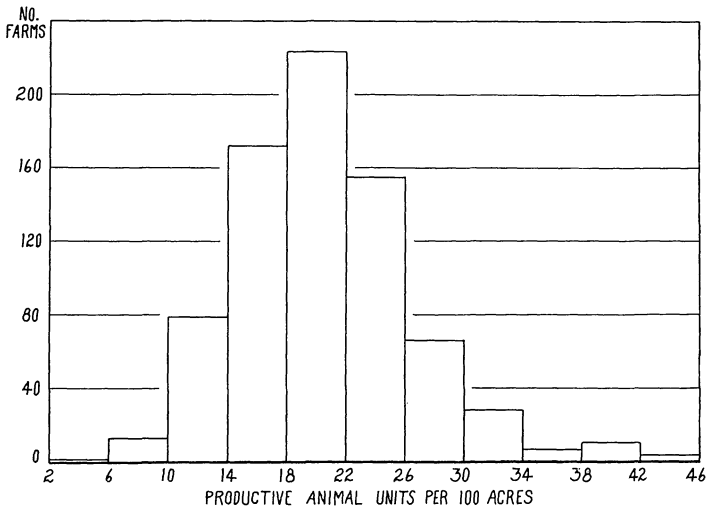

Fig. 11. Distribution of Farms Classified According to Productive Animal Units per 100 Acres

The bulk, or 73 per cent, of the farms kept somewhere between 14 and 26 animal units to each 100 acres in the farm.

in terms of productive animal units, the amount of livestock per 100 acres ranged from 5 to 45 units (see Figure 11). The bulk, or 73 per cent, of the farms kept somewhere between 14 and 26 animal units to each 100 acres in the farm. A range of from 18 to 22 units included 30 per cent of the farms.

Relation of productive animal units per 100 acres to other organization and management factors.—Generally, it was the small farms that kept the most livestock per 100 acres. However, the farms with the most livestock per 100 acres also had the largest total numbers of productive animal units (see Table 31). The farms relatively high in productive animal units per 100 acres exceeded those lower in that respect in size of business, as measured by productive man work units, notwithstanding the fact that they were much smaller in acres per farm. A higher percentage of the work was performed on livestock. The farmers keeping an average of 34 productive animal units per 100 acres performed an average of 586 productive man work units to each 100 acres in their farms, as compared with a performance of 198 work units to each 100 acres by those keeping an average of 7 productive animal units per 100 acres. There was a progressive increase in the total productive man work units performed on the farm as the productive animal units per 100 acres increased.

The progressively larger number of productive animal units per 100 acres was made possible by correspondingly higher indexes of crop

Table 31

Relation of Productive Animal Units per 100 Acres to Other Organization and Management Factors, 1928-32

Productive animal units per 100 acres	No. of farms in group	Productive animal units per 100 acres	Productive animal units per farm	Area in farm, acres	Percentage of land tillable	Productive man work units	P.M.W.U.* per 100 acres in farm
9 and less	14	7	16	261	75	517	198
10-13	79	12	28	231	74	622	269
14-17	172	16	34	212	74	668	315
18-21	232	20	36	180	75	655	364
22-25	155	23	38	165	78	719	435
26-29	66	27	40	147	78	696	474
30 and more	48	34	44	128	79	750	586

	Percentage of P.M.W.U.* on livestock	Index of crop selection, per cent	Index of crop yields, per cent	Butterfat per cow, lb.	Index of R.O.F.C.† from livestock other than cows, per cent	Index of pow., mch., and imp. exp. ‡ per P.M.W.U.,* per cent	Index of P.M.W.U.* per worker, per cent
9 and less	46	31.1	85	217	40	121	86
10-13	58	31.9	86	226	44	107	97
14-17	63	32.2	94	232	44	103	98
18-21	68	32.2	100	244	49	99	99
22-25	70	33.3	104	246	50	94	104
26-29	74	36.5	106	265	53	101	99
30 and more	75	40.9	115	261	51	93	102

* Productive man work units.
† Returns over feed cost.
‡ Power, machinery, and improvement expense.

selection and by higher crop yields (see Table 31). The higher yields were also supplemented with larger amounts of purchased feeds on the farms intensively stocked with livestock.

The farmers who kept relatively large amounts of livestock per 100 acres obtained a relatively high production per cow and returns over feed cost from livestock other than cows (see Table 31). They also made a more efficient use of labor, power, and equipment.

There was very little difference among the groups of farms classified on the basis of amount of livestock per 100 acres in the proportional numbers of units of the different classes of livestock kept (see Table 32). There was some substitution of poultry for hogs in the groups relatively high in productive animal units per 100 acres.

Table 32

Relationship Between Amount of Livestock per 100 Acres and the Proportional Distribution of Choice of Kinds of Livestock, 1928-32

Productive animal units per 100 acres	No. of farms in group	Productive animal units per 100 acres	Percentage of productive animal units that were				
			Cows	Cattle	Hogs	Sheep	Poultry
9 and less.....	14	7	39	22	26	7	6
10—13	79	12	49	27	19	1	4
14—17	172	16	46	26	20	4	4
18—21	232	20	46	26	17	4	7
22—25	155	23	47	24	25	3	1
26—29	66	27	46	26	19	4	5
30 and more.....	48	34	47	25	18	3	7

Relation of amount of livestock per 100 acres to earnings.—In each of the years during the period 1928-31, the farmers in southeastern Minnesota who kept a relatively large amount of livestock per 100 acres obtained higher earnings (1928-30) or had smaller losses (1931). The comparisons in Table 33 indicate that the advantage derived from heavy stocking with livestock was greater in 1928 and 1929 than during the period 1930-32. As shown in Table 31, the farms high in productive animal units per 100 acres represented a larger volume of business. The larger volume of business was an advantage in 1928 and 1929, whereas during the period 1930-32 it was a factor in lowering earnings on the majority of farms (see Table 23). The disadvantage of heavy stocking with livestock in 1932 among all groups except the group highest in productive animal units per 100 acres, as compared with the four preceding years, was largely the result of the relatively low prices received for hogs in 1932. There was an average loss of 56 cents in 1932 on the feed used in the production of each 100 pounds of marketable hogs on the farms studied. The returns above feed cost from all classes of livestock were relatively low in 1932.

Table 33

Average Operator's Labor Earnings on Farms Classified According to Productive Animal Units per 100 Acres, 1928-32

Productive animal units per 100 acres	1928		1929	
	No. of farms in group	Operator's labor earnings	No. of farms in group	Operator's labor earnings
13 and less	16	$ 577	26	$1,268
14-17	32	1,122	45	1,716
18-21	42	1,379	52	1,707
22-25	19	1,617	32	2,329
26 and more	15	1,424	17	2,459

	1930		1931		1932	
	No. of farms in group	Operator's labor earnings	No. of farms in group	Operator's labor earnings	No. of farms in group	Operator's labor earnings
13 and less	28	—$88	10	—$1,017	13	—$734
14-17	43	27	27	—882	25	—880
18-21	50	195	38	—671	50	—883
22-25	35	428	42	—601	27	—1,031
26 and more	24	605	30	—361	28	—375

Differences in intensity of livestock production resulted in the greatest differences in adjusted earnings on medium-sized farms or those ranging from 140 to 219 acres (see Table 34). The smallest differences were on the large farms or those of 220 acres or more in size. An adequate volume of business usually can be attained on the large farms in other ways than through intensive livestock production. Hence there was less association between productive animal units per 100 acres and total productive man work units on the large farms than there was on the small and medium-sized farms.

Table 34

Average Adjusted Operator's Labor Earnings on Farms Classified According to Size of Business and Productive Animal Units Per 100 Acres, 1928-32

Productive animal units per 100 acres	All farms		Acres per farm					
			139 and less		140-219		220 and more	
	No. of farms in group	Adjusted operator's labor earnings	No. of farms in group	Adjusted operator's labor earnings	No. of farms in group	Adjusted operator's labor earnings	No. of farms in group	Adjusted operator's labor earnings
17 and less	265	$1,479	30	$1,063	122	$1,259	113	$1,828
18-21	232	1,530	63	1,284	121	1,538	48	1,835
22 and more	269	1,714	115	1,472	119	1,841	35	2,080

The rate of increase in earnings among the three groups of small farms was somewhat less between the two groups with 18 or more productive animal units per 100 acres than it was between those with 21 or less units (see Table 34). The feed used for workstock is ordinarily a larger proportion of the total production of feed on the

small farms than on large farms. Consequently, to attain the same intensity of livestock production on the small farms as on the larger ones, either higher yields must be obtained or a larger proportion of the feed must be purchased. Feeds ordinarily can be grown on the farm more cheaply than they can be purchased.

The comparisons in Table 31 indicated a marked association between production per cow and productive animal units per 100 acres. The association is further indicated in Table 35 in which the farms were first classified according to butterfat production before grouping them on the basis of productive animal units per 100 acres. Among the farmers with 17 and less productive animal units per 100 acres, 48 per cent obtained low butterfat production per cow as compared with 18 per cent that obtained high butterfat production per cow. While a part of the differences in earnings observed in Table 34 was the result of higher butterfat production and other associated factors, there were, as indicated in Table 35, differences in earnings among groups of farmers, classified according to productive animal units per 100 acres, that obtained about the same butterfat production per cow.

Table 35

Average Adjusted Operator's Labor Earnings on Farms Classified According to Size of Business, Pounds of Butterfat Per Cow, and Animal Units Per 100 Acres, 1928-32

Productive animal units per 100 acres	All farms		Acres per farm					
			139 and less		140-219		220 and more	
	No. of farms in group	Adjusted operator's labor earnings	No. of farms in group	Adjusted operator's labor earnings	No. of farms in group	Adjusted operator's labor earnings	No. of farms in group	Adjusted operator's labor earnings
Pounds of butterfat per cow, 224 and less								
17 and less.....	127	$1,240	15	$ 660	60	$1,051	52	$1,625
18-21	84	1,480	14	1,281	46	1,413	24	1,723
22 and more....	76	1,567	28	1,714	39	1,567	9	*
Pounds of butterfat per cow, 225-274								
17 and less.....	90	1,684	6	*	43	1,478	41	1,946
18-21	87	1,460	24	1,042	48	1,522	15	1,930
22 and more...	99	1,755	38	1,419	45	1,854	16	2,272
Pounds of butterfat per cow, 275 and more								
17 and less.....	48	1,730	9	*	19	1,417	20	2,115
18-21	61	1,701	25	1,517	27	1,781	9	*
22 and more...	94	1,790	49	1,374	35	2,129	10	2,645

* The number of farms is not large enough to give a significant average.

In general, differences in intensity in stocking with livestock resulted in greatest differences in earnings among groups of small farms with low butterfat production and among large farms with high butterfat production per cow (see Table 35). An adequate volume of business is highly important to the farmers on small farms. It may be attained on the dairy farm by heavy stocking, by obtaining high production per animal, or by a combination of the two. Ordinarily

it would be expected that an increase in the number of animal units per 100 acres would result in greater differences in earnings on small farms under conditions of high butterfat production per cow than under conditions of low butterfat production. However, because of the shortage of feed available for productive livestock on small farms, high production from a relatively large number of animals usually is accomplished by purchasing feeds. Another reason for the lower earnings on the 49 small farms (see Table 35) that were high in productive animal units per 100 acres and high in butterfat production, as compared with the 25 farms that were lower in productive animal units per 100 acres, was the association on small farms of high butterfat production per cow with a large supply of family labor that was not otherwise profitably employed.

Throughout the period of the study the relationship among the prices of farm products was favorable to livestock production as opposed to marketing feed crops directly. It may be expected therefore that the advantage of intensive livestock production indicated by this study will become less with a more normal price relationship between feed and livestock prices. The indexes of dairy and poultry prices were slightly higher than the index of hog prices during the first three years of the study, and they were considerably higher during 1931 and 1932. In the analysis of the farm records, however, no advantage in a choice of any one class of livestock was reflected in earnings during the period 1928-31. In 1932 farmers with a relatively large hog enterprise felt the effects of the price situation somewhat more than others who had curtailed the hog enterprise and expanded their poultry enterprise. In general, adjustments of the livestock system to the feed and labor supplies of the different farms were more important in their effect on earnings than were adjustments based on relative prices.

Efficiency in Production

Another phase of the farmer's function as a manager is to apply his labor and materials in the production of crops and livestock products in such a manner that they are produced economically. Economical production usually is obtained by following practices in the growing of crops and the care of livestock that are favorable to high yields per acre and high production per animal.

Crop Yields per Acre

Some farmers are handicapped in obtaining high yields, in comparison with their neighbors, by the low natural fertility of their land. Occasionally, lighter rainfall in some parts of a farming area than in others is responsible for a part of the differences among farmers in the crop yields obtained. The principal factors responsible for variation

in crop yields, however, are the character of the soil improvement programs followed on the various farms during the last ten years or more and the methods used in growing the crops. Regular use of a crop rotation including a legume, thoro tillage, the use of disease-free seeds of high-yielding and good-quality strains, the careful timing of the planting date, and the avoiding or combating of diseases and insects by approved methods are practices favorable to high yields.

Measure of crop yields.—In the following comparisons between the crop yields on a farm or groups of farms and other factors, the yields of the different crops on the various farms have been expressed in composite numbers or indexes that indicate the comparative crop yields on the different farms. An index of crop yields expresses on a percentage basis the crop yields on a particular farm compared with the average yields on other farms included in the study. All crops on tillable land and their proportionate areas are considered. The method used in determining the crop index for a given farm is described in the appendix on page 81.

Variation in index of crop yields.—The distribution of farms classified according to their index of crop yields is shown in Figure 12. The range in index was from 30 to 159. The bulk of the farms, however, were within a much smaller range as shown in Figure 12. The yields on 41 per cent of the farms were not more than 10 per cent less or 10 per cent greater than the average. There was only one farm on which the crop yields were more than 50 per cent below the average, and only 4 on which the yields were more than 50 per cent above the average.

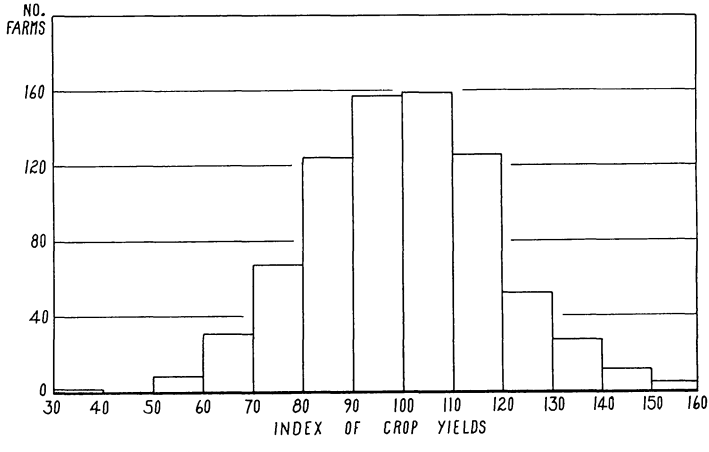

Fig. 12. Distribution of Farms Classified According to Index of Crop Yields
The yields on 41 per cent of the farms were not more than 10 per cent less or 10 per cent greater than the average.

As with the index of crop selection, the geographical location of the different farms was reflected in the yields obtained thereon. The extent of the influence of location in the area was shown in Table 4, in which the average index of crops yields of the 766 farms classified by counties was shown. The average index of crop yields in LeSueur County was 112.2 as compared with 87.1 in Dodge County.

Relation of index of crop yields to other organization and management factors.—An association between crop yields and choice of crops was indicated in Table 27. The farmers who choose crops that may be expected to contribute most to the returns of the farm are also the ones who, on the average, obtain the highest yields. High-yielding land is favorable to the production of a relatively larger acreage of such crops as corn and legumes, and the production of legume crops may help to build up the productivity of the land.

The farms with high yields were somewhat smaller than those with low yields (see Table 36), which indicates that the farmers on small farms gave more attention to obtaining good crop yields. It is also significant that the farms on which relatively high yields were obtained were valued higher per acre. The higher values being associated with small farms reflected higher improvement values per acre on the small farms as well as higher productivity.

Table 36

Relation of Index of Crop Yields to Other Organization and Management Factors, 1928-32

Index of crop yields, per cent	No. of farms in group	Productive man work units	Area per farm, acres	Value of real estate per acre	Index of crop selection, per cent
62 and less	16	680	229	$ 72	26.6
63-77	76	725	212	77	29.1
78-92	190	621	191	84	30.7
93-107	243	675	183	90	33.8
108-122	164	672	168	99	36.2
123-137	57	765	177	108	37.0
138 and more	20	736	157	110	37.6

	Productive animal units per 100 acres	Butterfat per cow, lb.	Index of R.O.F.C.* from livestock other than cows, per cent	Index of P.M.W.U.† per worker, per cent	Index of pow., mch., and imp. exp.‡ per P.M.W.U.,† per cent
62 and less	15.4	229	42	101	98
63-77	17.4	215	45	102	94
78-92	17.8	237	47	101	101
93-107	20.4	243	48	100	100
108-122	21.4	257	49	97	102
123-137	24.3	253	49	97	100
138 and more	26.6	252	54	100	100

* Returns over feed cost.
† Productive man work units.
‡ Power, machinery, and improvement expense.

Progressively higher yields made possible progressively heavier stocking with livestock, which resulted in a larger volume of business measured in productive man work units on the farms with high yields despite the fact that they were much smaller in acreage than the farms with low yields. High crop yields were also associated with high butterfat production per cow and high returns over feed cost.

There was no association, however, between crop yields and the amount of work accomplished per man or the cost of power, machinery, and improvements per day of work.

Relation of index of crop yields to earnings.—In Table 37 are shown the average operator's labor earnings by years, from 1928 to 1932, of groups of farms classified according to the index of crop yields. A comparison of the earnings of the different groups indicates that farmers who obtained relatively high crop yields obtained progressively higher earnings or smaller losses in almost every instance than those with lower yields.

When the records for the five years are combined as in Table 38 and the adjusted earnings are compared, it is observed that the farmers who obtained an index of crop yields of 110 or more had earnings that averaged $761 higher than the earnings obtained by the farmers whose index of crop yields was 89 or less. It is also shown in Table 38 that differences in crop yields were responsible for greater differences in earnings on the large farms than on the small ones. The corresponding differences in earnings on small, medium, and large farms were $409, $515, and $1,043, respectively.

Table 37

Average Operator's Labor Earnings on Farms Classified According to Index of Crop Yields, 1928-32

Index of crop yields, per cent	1928		1929	
	No. of farms in group	Operator's labor earnings	No. of farms in group	Operator's labor earnings
77 and less	12	$ 254	18	$ 782
78-92	35	1,044	44	1,669
93-107	39	1.353	53	1,881
108-122	25	1,802	42	1,980
123 and more	13	1,445	15	2,905

	1930		1931		1932	
	No. of farms in group	Operator's labor earnings	No. of farms in group	Operator's labor earnings	No. of farms in group	Operator's labor earnings
77 and less.	19	—$153	27	—$1,041	16	—$689
78-92	50	102	30	—833	31	—993
93-107	56	159	41	—677	54	—872
108-122	41	399	25	—500	31	—696
123 and more.	14	751	24	—94	11	—323

Table 38

Average Adjusted Operator's Labor Earnings on Farms Classified According to Size of Business and Index of Crop Yields, 1928-32

Index of crop yields, per cent	All farms		Productive man work units					
			499 and less		500-799		800 and more	
	No. of farms in group	Adjusted operator's labor earnings	No. of farms in group	Adjusted operator's labor earnings	No. of farms in group	Adjusted operator's labor earnings	No. of farms in group	Adjusted operator's labor earnings
89 and less.....	230	$1,306	62	$ 903	121	$1,307	47	$2,045
90-109	316	1,620	99	1,027	147	1,646	70	2,402
110 and more...	220	2,067	50	1,312	103	1,822	67	3,088

The comparisons in Tables 27 and 36 indicated a close association between crop yields and choice of crops. Consequently, each of the groups in Table 38 was classified according to index of crop selection as shown in Table 39 in order to set forth the results of differences in crop yields under conditions in which the choice of crops was approximately the same. In Table 39 it is observed that progressively higher crop yields resulted in higher earnings even tho they were not accompanied by a correspondingly better choice of crops. The increases in earnings associated with differences in crop yields are greater, however, under conditions of a high index of crop selection than under conditions of a poor selection of crops. The difference in adjusted earnings between the group having an index of crop yields of 89 and less and the one with an index of crop yields of 110 and more was $250 on the farms with a low index of crop selection, $654 on those with a medium index of crop selection, and $1,159 on those with a high index of crop selection (see Table 39).

Table 39

Average Adjusted Operator's Labor Earnings on Farms Classified According to Size of Business, Index of Crop Selection, and Crop Yields, 1928-32

Index of crop yields, per cent	All farms		Productive man work units					
			499 and less		500-799		800 and more	
	No. of farms in group	Adjusted operator's labor earnings	No. of farms in group	Adjusted operator's labor earnings	No. of farms in group	Adjusted operator's labor earnings	No. of farms in group	Adjusted operator's labor earnings
Index of crop selection 29 and less								
89 and less.....	114	$1,307	29	$ 936	58	$1,140	27	$2,064
90-109	99	1,289	35	854	46	1,351	18	1,974
110 and more...	36	1,557	9	*	20	1,644	7	*
Index of crop selection 30-39								
89 and less.....	95	1,306	29	804	51	1,423	15	1,876
90-109	160	1,721	45	1,093	81	1,792	34	2,385
110 and more...	107	1,960	21	1,417	51	1,712	35	2,647
Index of crop selection 40 and more								
89 and less....	21	1,296	4	*	12	1,621	5	*
90-109	57	1,909	19	1,191	20	1,732	18	2,863
110 and more...	77	2,455	20	1,404	32	2,109	25	3,740

* The number of farms is not large enough to give a significant average.

Butterfat Production Per Cow

An indicator of economical production in the dairy enterprise is butterfat production per cow. Farmers vary widely in this respect as indicated in Figure 13 in which is shown a distribution of farms classified according to pounds of butterfat produced per cow. The range was from 110 to 425 pounds. A production per cow of approximately 250 pounds of butterfat was obtained most frequently. The five class intervals in Figure 13, including those farms having a butterfat production per cow ranging from 200 to 300 pounds, included 70 per cent of the farms.

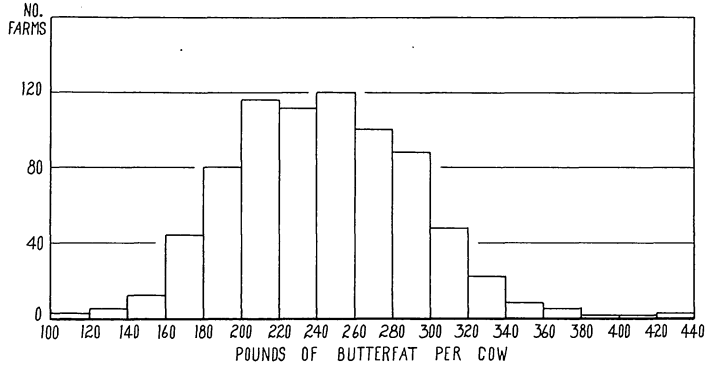

Fig. 13. Distribution of Farms Classified According to Pounds of Butterfat per Cow
The five class intervals including those farms having a butterfat production per cow ranging from 200 to 300 pounds included 70 per cent of the farms.

Table 40

Relation of Pounds of Butterfat per Cow to Other Organization and Management Factors 1928-32

Pounds of butterfat per cow	No. of farms in group	Productive man work units	Productive animal units per 100 acres	Index of crop selection, per cent	Index of crop yields, per cent
149 and less	13	558	17	31	86
150-189	95	702	17	32	92
190-229	205	695	20	34	96
230-269	234	687	20	33	100
270-309	161	664	21	33	105
310-349	43	594	23	36	101
350 and more	15	470	21	33	108

Pounds of butterfat per cow	Index of returns over feed cost from: Cows, per cent	Cattle other than cows, per cent	All livestock, per cent	Index of productive man work units per worker, per cent	Index of pow., mch., and imp. exp. per P.M.W.U.,* per cent
149 and less	19	47	34	105	109
150-189	28	44	37	101	98
190-229	34	46	41	103	95
230-269	42	48	46	100	101
270-309	49	51	50	95	104
310-349	59	52	55	95	102
350 and more	68	53	61	100	94

* Power, machinery, and improvement expense per productive man work unit.

Relation of pounds of butterfat per cow to other organization and management factors.—Many of the relationships between butterfat production per cow and the farm organization factors have already been indicated in previous tables. Those relationships, together with others not previously shown, are brought together in Table 40. An important relationship not previously shown is the association between pounds of butterfat per cow and an index of returns over feed cost from cows. A consistent increase in returns over feed cost from cows accompanied a progressively higher production of butterfat per cow. It is also significant that the returns over feed cost from other cattle was associated with butterfat production per cow. Farmers who obtained relatively high butterfat production per cow, however, did not accomplish more work per man nor did they secure production with any less expense per unit of man labor.

Relation of pounds of butterfat to earnings.—In each of the years during the period, 1928-32, the farmers in southeastern Minnesota who obtained relatively high production of butterfat per cow realized higher earnings (1928-30) or had smaller losses (1931-32). The groupings in Table 41 demonstrate that in practically every comparison the farmers who obtained the higher butterfat production per cow had the higher earnings. The difference in earnings in 1929 between the group lowest in butterfat production per cow and the group highest in that respect was $1,357. In 1931 the corresponding difference was $1,019; in 1928 and 1930 it was $786 and $676, respectively. The difference in earnings associated with higher butterfat production per cow was neither so consistent nor so great in 1932 as in the other years (see Table 41).

Table 41

Average Operator's Labor Earnings on Farms Classified According to Pounds of Butterfat per Cow, 1928-32

Pounds of butterfat	1928		1929	
	No. of farms in group	Operator's labor earnings	No. of farms in group	Operator's labor earnings
189 and less	19	$ 792	22	$1,094
190-229	35	1,188	44	1,684
230-269	29	1,542	49	1,840
270-309	33	1,279	40	2,131
310 and more	8	1,578	17	2,451

	1930		1931		1932	
	No. of farms in group	Operator's labor earnings	No. of farms in group	Operator's labor earnings	No. of farms in group	Operator's labor earnings
189 and less.	22	—$46	21	—$1,254	24	—$927
190-229	54	61	36	—617	36	—681
230-269	56	165	53	—521	47	—935
270-309	36	518	26	—649	26	—642
310 and more	12	630	11	—235	10	—660

Table 42

Average Adjusted Operator's Labor Earnings on Farms Classified According to Size of Business and Pounds of Butterfat Per Cow, 1928-32

Pounds of butterfat per cow	All farms		Productive man work units					
			499 and less		500-799		800 and more	
	No. of farms in group	Adjusted operator's labor earnings	No. of farms in group	Adjusted operator's labor earnings	No. of farms in group	Adjusted operator's labor earnings	No. of farms in group	Adjusted operator's labor earnings
224 and less....	287	$1,472	70	$ 813	142	$1,363	75	$2,295
225-274	276	1,711	69	1,026	143	1,655	64	2,575
275 and more..	203	1,882	72	1,328	86	1,832	45	2,863

When the records of the five-year period are combined and the association between production per cow and the adjusted earnings on farms of approximately the same size is measured, it appears that a relatively high production per cow did not result in appreciably greater differences in earnings on the farms with a large business than on the farms with a small business (see Table 42). There were more high-producing cows on the large farms, but the high production was not obtained as economically as on the small farms.

Table 43

Average Adjusted Operator's Labor Earnings on Farms Classified According to Size of Business, Index of Crop Yields, and Pounds of Butterfat Per Cow, 1928-32

Pounds of butterfat per cow	All farms		Productive man work units					
			499 and less		500-799		800 and more	
	No. of farms in group	Adjusted operator's labor earnings	No. of farms in group	Adjusted operator's labor earnings	No. of farms in group	Adjusted operator's labor earnings	No. of farms in group	Adjusted operator's labor earnings
Index of crop yields 89 and less								
224 and less....	113	$1,108	34	$ 696	58	$1,135	21	$1,702
225-274	86	1,666	14	1,144	48	1,450	24	2,401
275 and more...	31	1,714	14	1,162	15	2,275	2	*
Index of crop yields 90-109								
224 and less....	114	1,541	24	793	60	1,492	30	2,239
225-274	109	1,548	39	947	53	1,690	17	2,487
275 and more...	93	1,797	36	1,270	34	1,849	23	2,545
Index of crop yields 110 and more								
224 and less....	60	2,028	12	1,183	24	1,593	24	2,885
225-274	81	1,978	16	1,115	42	1,845	23	2,821
275 and more...	79	2,470	22	1,527	37	1,944	20	3,379

* The number of farms is not large enough to give a significant average.

It was observed in Table 40 that a relatively high production per cow was accompanied by a relatively high index of crop yields. Consequently, to observe the influence on earnings of different rates of

butterfat production on farms on which approximately the same crop yields were obtained, each of the groups shown in Table 42 was subdivided on the basis of crop yields as shown in Table 43. In Table 43 it will be observed that differences in butterfat production per cow were responsible for differences in earnings even tho they were not accompanied by corresponding differences in crop yields. In general, differences in butterfat production per cow were accompanied by greater differences in earnings on the farms with low crop yields than they were on farms with high crop yields.

Returns Over Feed Cost From Livestock Other than Cows

Paralleling butterfat production per cow as an indicator of economical livestock production is returns over feed cost from livestock other than cows.

Measure of returns over feed cost.—In the following comparisons between returns over feed cost from livestock other than cows and other factors, the returns over feed cost from the different classes of livestock other than cows on the various farms have been expressed as indexes that indicate the comparative returns on the different farms. The indexes of the separate classes of livestock have been combined into a single weighted index. The method used in determining the index for a particular farm is described in the appendix on page 82.

Variation in index of returns over feed cost.—The distribution of farms classified according to their index of returns over feed cost from livestock other than cows is shown in Figure 14. Approximately 75 per cent of the farms were in 30 per cent of the range; that is, the indexes of returns over feed cost were between 35 and 65.

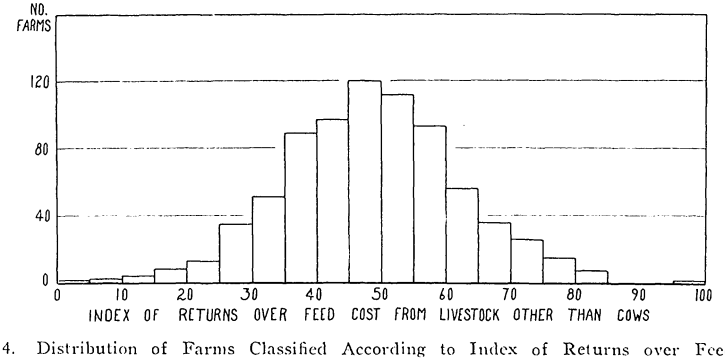

Fig. 14. Distribution of Farms Classified According to Index of Returns over Feed Cost from Livestock Other than Cows

Thirty per cent of the range, or an index of from 35 to 65, included approximately 75 per cent of the range.

Relation of index of returns over feed cost to other organization and management factors.—Returns over feed cost from livestock other than cows were not associated with size of business or choice of crops. They were associated with crop yields, however, and as a result the index of returns over feed cost was highest, on the average, on those farms most heavily stocked per acre with livestock. A relatively larger proportion of the total animal units was hogs and a smaller proportion was cattle on the farms on which returns over feed cost were relatively high (see Table 44).

There was no association between the index of returns over feed cost from livestock other than cows and the index of returns over feed cost from cows, notwithstanding the fact that there was some association between returns over feed cost from livestock other than cows and production of butterfat per cow (see Table 44).

The accomplishment of high returns over feed cost did not influence the amount of work performed per worker. Neither did it influence the amount of power, machinery, and improvement expense per man work unit.

Relation of index of returns over feed cost to earnings.—In Table 45 is shown the average operator's labor earnings by years, from 1928 to 1932, of groups of farms classified according to index of returns over feed cost from livestock other than cows. A comparison of the earnings indicates that farmers who obtained high returns over feed cost also obtained relatively high earnings or small losses. The range in differences in earnings among the five groups of farms shown in Table 45 was from $856 in 1931 to $1,725 in 1929. In 1928 and 1930 the range in differences was $1,133 and $1,116, respectively. In 1932 there was no consistent relationship between returns over feed cost and earnings. In other years the differences in earnings were larger between the groups of farms with a relatively low index of returns over feed cost than they were between groups with an index that was above the average.

When the records for the five years are combined as in Table 46 and the adjusted earnings are compared, it is observed that the farmers who obtained an index of returns over feed cost of 50 and more had earnings that were $646 higher than the earnings obtained by the farmers whose index of returns over feed cost was 39 and less. It is also shown in Table 46 that differences in returns over feed cost were responsible for greater differences in earnings on the large farms than on the small ones. The corresponding differences on small and large farms were $571 and $790, respectively.

Table 44

Relation of Index of Returns Over Feed Cost from Livestock Other Than Cows to Other Organization and Management Factors, 1928-32

Index of returns over feed cost from livestock other than cows, per cent	No. of farms in group	Productive man work units	Index of crop selection, per cent	Productive animal units per 100 acres	Percentage of productive animal units that were				
					Cows	Other cattle	Hogs	Sheep	Poultry
24 and less	28	676	32.0	16.1	51.7	28.7	12.3	2.3	5.0
25-34	86	689	32.2	18.5	50.3	26.9	14.6	4.1	4.1
35-44	186	694	32.9	19.1	47.2	26.6	18.5	3.2	4.5
45-54	232	673	33.9	20.6	45.7	25.3	20.7	3.7	4.6
55-64	149	663	33.9	21.0	44.9	23.6	23.0	3.4	5.1
65-74	62	658	33.1	21.4	45.0	23.6	24.1	3.5	3.8
75 and more	23	587	31.6	21.9	45.2	23.8	22.1	3.1	5.8

	Index of livestock efficiency, per cent					Butterfat per cow, lb.	Index of crop yields, per cent	Index of P.M.W.U.* per worker, per cent	Index of pow., mch., imp. exp.† per P.M.W.U.,* per cent
	Cows	Other cattle	Hogs	Sheep	Poultry				
24 and less	45	16	25	6	37	228	93	96	105
25-34	39	21	44	10	36	226	99	93	101
35-44	40	26	58	15	41	237	97	102	100
45-54	41	36	63	16	41	245	100	98	98
55-64	41	44	70	17	44	247	102	103	100
65-74	42	59	77	20	44	256	99	103	103
75 and more	40	83	64	26	55	265	104	99	101

* Productive man work units per worker.
† Power, machinery, and improvement expense.

Table 45

Average Operator's Labor Earnings on Farms Classified According to Index of Returns Over Feed Cost from Livestock Other Than Cows, 1928-32

Index of returns over feed cost from livestock other than cows, per cent	1928		1929	
	No. of farms in group	Operator's labor earnings	No. of farms in group	Operator's labor earnings
34 and less	15	$ 452	35	$1,214
35-44	24	1,279	65	1,780
45-54	32	1,254	43	1,876
55-64	29	1,398	26	2,599
65 and more	24	1,585	3	2,939

	1930		1931		1932	
	No. of farms in group	Operator's labor earnings	No. of farms in group	Operator's labor earnings	No. of farms in group	Operator's labor earnings
34 and less	33	—$309	12	—$1,112	19	—$873
35-44	49	—18	26	—961	22	—959
45-54	52	280	51	—698	54	—771
55-64	26	705	23	—463	35	—675
65 and more	20	807	25	—256	13	—855

Table 46

Average Adjusted Operator's Labor Earnings on Farms Classified According to Size of Business and Index of Returns Over Feed Cost from Livestock Other Than Cows, 1928-32

Index of returns over feed cost from livestock other than cows, per cent	All farms		Productive man work units					
			499 and less		500-799		800 and more	
	No. of farms in group	Adjusted operator's labor earnings	No. of farms in group	Adjusted operator's labor earnings	No. of farms in group	Adjusted operator's labor earnings	No. of farms in group	Adjusted operator's labor earnings
39 and less	203	$1,282	64	$ 722	92	$1,260	47	$2.087
40-49	217	1,611	48	1,022	116	1,505	53	2,377
50 and over	346	1,928	99	1,293	163	1,824	84	2,877

The comparisons in Table 44 indicated a close association between returns over feed cost and crop yields. Consequently each of the groups in Table 46 was classified according to index of crop yields, as shown in Table 47, in order to set forth the results of differences in returns over feed costs under conditions in which the yield of crops was approximately the same. In Table 47 it is observed that differences in returns over feed cost resulted in differences in earnings even tho they were not accompanied by appreciable differences in crop yields. The differences in earnings shown in Table 47 were only slightly less than those shown in Table 46.

Table 47

Average Adjusted Operator's Labor Earnings on Farms Classified According to Size of Business, Index of Crop Yields, and Index of Returns Over Feed Cost from Livestock Other Than Cows, 1928-32

Index of returns over feed cost from livestock other than cows, per cent	All farms		Productive man work units					
			499 and less		500-799		800 and more	
	No. of farms in group	Adjusted operator's labor earnings	No. of farms in group	Adjusted operator's labor earnings	No. of farms in group	Adjusted operator's labor earnings	No. of farms in group	Adjusted operator's labor earnings
			Index of crop yields 89 and less					
39 and less.....	69	$ 972	22	$ 483	32	$1,041	15	$1,544
40-49	70	1,407	9	934	46	1,292	15	2,043
50 and more...	91	1,590	31	1,192	43	1,521	17	2,488
			Index of crop yields 90-109					
39 and less.....	83	1,282	32	795	33	1,317	18	2,082
40-49	92	1,570	24	942	49	1,527	19	2,475
50 and more....	141	1,849	43	1,248	65	1,901	33	2,529
			Index of crop yields 110 and more					
39 and less.....	51	1,702	10	1,017	27	1,452	14	2,675
40-49	55	1,936	15	1,200	21	1,918	19	2,538
50 and more....	114	2,294	25	1,497	55	1,967	34	3,409

In Table 48 is shown the combined effect on adjusted earnings of differences in efficiency in the production of all livestock. Efficiency in dairying was measured by an index of returns over feed cost from dairy cows. This index was combined with the index of returns over feed cost from livestock other than cows to provide a weighted index of returns over feed cost from all livestock. Differences in the combined index resulted in larger differences in earnings than indicated in Table 42 or 46, in which the relation to earnings of butterfat production per cow and index of returns over feed cost from livestock other than cows were shown, respectively. The difference in earnings between the group of farms on which the index of returns over feed cost was low and the group on which it was high was $893. When the high and low index groups were broken down into size of farm groups, the corresponding differences in earnings on small, medium, and large farms were $784, $867, and $1,396, respectively.

Table 48

Average Adjusted Operator's Labor Earnings on Farms Classified According to Size of Business and Index of Returns Over Feed Cost from Livestock, 1928-32

Index of returns over feed cost from livestock, per cent	All farms		Productive man work units					
			499 and less		500-799		800 and more	
	No. of farms in group	Adjusted operator's labor earnings	No. of farms in group	Adjusted operator's labor earnings	No. of farms in group	Adjusted operator's labor earnings	No. of farms in group	Adjusted operator's labor earnings
39 or less.....	236	$1,156	58	$ 603	123	$1,146	55	$1,762
40-49	275	1,749	69	1,036	131	1,613	75	2,644
50 and more...	255	2,049	84	1,387	117	2,013	54	3,158

Productive Man Work Units Per Worker[10]

The annual cost of labor is a very large item of farm expense. It follows that operator's labor earnings will be higher on farms that have a low labor expense as a result of efficient use of labor.

Variation in productive man work units per worker.—The range in the effectiveness of the use of labor on the group of farms studied is indicated in Figure 15. The farmer performing the least amount of work accomplished the equivalent of only 110 productive man work units (10-hour days of work), whereas the man who obtained the most efficient utilization of his labor accomplished the equivalent of 688 productive man work units per worker. The most usual number of productive man work units per worker was from 300 to 350. Sixty-four per cent of the farmer's accomplishments in the effective use of labor were within the range of from 250 to 400 productive man work units per worker.

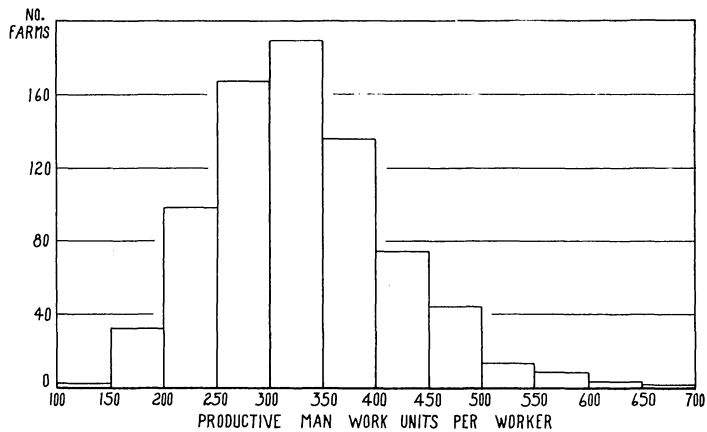

Fig. 15. Distribution of Farms Classified According to Index of Productive Man Work Units per Worker

The most usual number of productive man work units per worker was from 300 to 350. Sixty-four per cent of the farmers performed the equivalent of from 250 to 400 10-hour days of productive work.

Relation of productive man work units per worker to other organization and management factors.—The effect of the size of the business on the amount of work accomplished per worker was indicated in Table 22. The opportunities afforded for more effective use of labor is one of the outstanding advantages of large-scale operations. There are opportunities, however, for accomplishing a more effective use of labor through other channels than that of increasing the size of the farm business. This is indicated by observing the variation in pro-

[10] For method of computing productive man work units per worker, see appendix, page 82.

ductive man work units per worker among farms of approximately the same size. The influence of size of business on the number of productive man work units per worker has been corrected by expressing the productive man work units performed per worker on the different farms as a percentage of the average productive man work units per worker of the farms of the respective size groups. The relation between the index of productive man work units per worker and certain organization and management factors is shown in Table 49.

Table 49

Relation of Index of Productive Man Work Units per Worker to Other Organization and Management Factors, 1928-32

Index of productive man work units per worker, per cent	No. of farms in group	Productive man work units per worker	No. of farm workers	Percentage of labor by			Percentage of productive man work units on livestock
				Proprietor	Family workers	Hired workers	
74 and less	77	211	2.7	48	33	19	27.7
75- 84	114	261	2.4	51	25	24	27.9
85- 94	150	298	2.3	52	21	27	27.8
95-104	144	330	2.1	56	16	28	28.0
105-114	108	364	1.9	59	17	24	27.3
115-124	76	387	1.9	64	18	18	26.2
125 and more	97	451	1.6	71	13	16	28.3

	Index of crop selection, per cent	Productive animal units per 100 acres	Percentage of productive animal units that were		Butterfat per cow, lb.	Index of crop yields, per cent	Index of pow., mch., imp. exp. per P.M.W.U.,* per cent
			Cows	Hogs			
74 and less	32.2	18.3	49.6	17.2	252	101	110
75- 84	33.1	19.0	48.4	17.9	240	99	100
85- 94	33.1	19.8	47.1	18.7	246	99	101
95-104	33.7	20.3	45.0	21.0	249	100	102
105-114	33.9	20.8	45.7	21.5	242	101	100
115-124	33.8	21.3	46.2	21.7	237	100	96
125 and more	32.7	20.6	44.8	21.6	228	96	90

* Index of power, machinery, and improvement expense per productive man work unit.

It will be observed from Table 49 that the only difference of significance among the groups of farms varying in effective use of labor was the organization of the labor force. On the farms on which there was relatively high efficiency in the use of labor, a high percentage of the labor was performed by the proprietor and a relatively low percentage by other members of the family. The farms most efficient in the use of labor also used less hired labor. There were little, if any, differences among the groups in the percentage distribution of work between crops and livestock, the index of crop selection, productive animal units per 100 acres, and index of crop yields. Hogs represented a slightly higher proportion and cows a slightly lower proportion of the combinations of livestock on the farms on which the most efficient use of labor was obtained. Butterfat production was somewhat lower on the farms on which labor was used most efficiently. There was a direct association, however, between efficiency in the use

of labor and economy in power, machinery, and improvement expense per productive man work unit.

Relation of index of productive man work units per worker to earnings.—In Table 50 is shown the average operator's labor earnings by years, from 1928 to 1932, of groups of farms classified according to the index of productive man work units per worker. There is a direct relationship between efficiency in the use of labor and earnings in each of the five years. The comparison of the farms on which the index of productive man work units per worker was below 75 with those on which the index was 115 or more shows a difference in average earnings of $1,104 in 1928, $843 in 1929, $1,002 in 1930, $913 in 1931, and $395 in 1932. A difference of 20 points in the index, as indicated by the two middle groups in Table 50, was responsible in each of the five years for an average difference in earnings of approximately $200.

Table 50

Average Operator's Labor Earnings on Farms Classified According to Index of Productive Man Work Units per Worker, 1928-32

Index of productive man work units per worker, per cent	1928		1929	
	No. of farms in group	Operator's labor earnings	No. of farms in group	Operator's labor earnings
74 and less	21	$ 456	23	$1,317
75-94	38	1,221	67	1,733
95-114	36	1,528	48	1,988
115 and more	29	1,560	34	2,160

	1930		1931		1932	
	No. of farms in group	Operator's labor earnings	No. of farms in group	Operator's labor earnings	No. of farms in group	Operator's labor earnings
74 and less.	15	—$397	8	—$1,347	10	—$989
75-94	61	—2	43	—691	55	—878
95-114	63	306	58	—665	47	—798
115 and more	41	605	38	—434	31	—594

As with many of the other factors previously discussed, effective use of labor was more important to the farmers with a large business than to those with a small business. This is indicated in Table 51 in which is shown the average adjusted operator's labor earnings on farms classified according to size of business and amount of work accomplished per worker. The difference in earnings between the groups of farms on which productive man work units per worker was less than 275 and the groups on which that accomplishment was 425 or more was $374 on the small farms, $771 on the medium-sized farms, and $823 on the large farms.

Table 51

Average Adjusted Operator's Labor Earnings on Farms Classified According to Productive Man Work Units per Worker, 1928-32

Productive man work units per worker	All farms		Productive man work units					
			499 and less		500-799		800 and more	
	No. of farms in group	Adjusted operator's labor earnings	No. of farms in group	Adjusted operator's labor earnings	No. of farms in group	Adjusted operator's labor earnings	No. of farms in group	Adjusted operator's labor earnings
274 and less...	221	$1,094	121	$ 933	89	$1,220	11	$1,865
275-424	447	1,788	88	1,226	246	1,656	113	2,512
425 and over...	98	2,404	2	1,307	36	1,991	60	2,688

Power, Machinery, and Improvement Expense per Productive Man Work Unit

Another important item of expense that varies widely among farms is the annual cost of power, machinery, equipment, and improvements associated with each productive man work unit.[11] The extent of the variation in this expense item is shown in Figure 16. The range in variation was from 15 to 213 per cent of the average. On 60 per cent of the farms, however, the variation from the average was not more than 20 per cent.

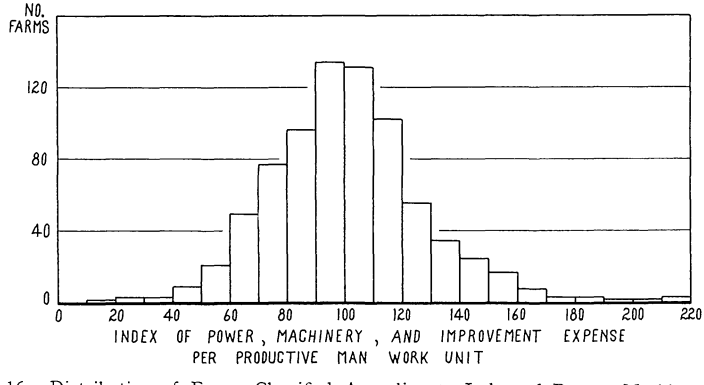

Fig. 16. Distribution of Farms Classified According to Index of Power, Machinery, and Improvement Expense per Productive Man Work Unit

Variation in the index may be the result either of the performance of a small amount of productive work on the farm or of relatively high expenses for power, machinery, and improvements

Relation of index of power, machinery, and improvement expense to other organization and management factors.—As indicated in Table 52 a high index of power, machinery, and improvement expense per productive man work unit is in part the result of a relatively small volume of business and in part the result of relatively high ex-

[11] For method of computing the index of power, machinery, and improvement expense per productive man work unit, see appendix, page 83.

pense for one or more of the items. The annual cost of power and machinery was closely related to the percentage of the total work that was performed on crops. There was no relation, however, between the choice of crops and the annual cost per man work unit of power, machinery, and improvements. Relatively high expense for the three items did not result in correspondingly high crop yields or butterfat production per cow.

Table 52

Relation of Index of Power, Machinery, and Improvement Expense per Productive Man Work Unit to Other Organization and Management Factors, 1928-32

Index of power, machinery, and improvement expense per productive man work unit, per cent	No. of farms in group	Index of power, machinery, and improvement expense per productive man work unit, per cent				Productive man work units
		Total	Power	Machinery	Improvements	
138 and more	62	155	145	150	192	555
123-137	67	129	127	125	129	693
108-122	139	114	115	112	110	660
93-107	202	100	101	98	100	677
78- 92	156	85	85	88	81	696
63- 77	99	71	71	72	67	702
62 and less	41	51	55	55	34	710

	Percentage of P.M.W.U.* on crops	Index of crop selection, per cent	Productive animal units per 100 acres	Index of crop yields, per cent	Butter-fat per cow, lb.	Index of productive man work units per worker, per cent
138 and more	29.9	31.8	18.0	101	241	90
123-137	29.3	35.1	19.0	102	252	95
108-122	29.5	32.6	18.9	99	249	97
93-107	27.6	34.1	20.6	99	242	100
78- 92	27.0	32.5	20.4	100	235	104
63- 77	25.4	33.6	21.3	100	244	105
62 and less	24.8	32.5	21.1	93	231	100

* Productive man work units.

Relation of index of power, machinery, and improvement expense to earnings.—The average operator's labor earnings by years, from 1928 to 1932, of groups of farms classified according to index of power, machinery, and improvement expense per productive man work unit is shown in Table 53. In 1928 there were considerable differences in earnings in favor of the progressively lower index of expense. On the farms on which the index was 77 or less the earnings were $865 higher than on the farms on which the index was 123 and more. In 1929 when the prices of farm products were such as to make agricultural production reasonably profitable, the farms that had the lowest expenses were not the ones that had highest earnings. In 1929 it was on the farms on which the index of expenses was approximately the average of the group that the earnings were highest. Farms with a low index had higher earnings, however, than those with a high index (see Table 53). In 1930 earnings were not closely related to the index of expense. In 1931 and 1932, when the prices

of farm products were low, economizing on expense items was one of the most effective means of averting a heavy loss from the year's operations. In 1931 the average loss on the group of farms with an index of expense of 77 and less was $13 as compared with $1,208 on the group of farms with an index of 123 and more, a difference of $1,195. In 1932 the corresponding difference was $568.

Table 53

Average Operator's Labor Earnings on Farms Classified According to Index of Power, Machinery, and Improvement Expense per Productive Man Work Unit, 1928-32

Index of power, machinery, and improvement expense per productive man work unit, per cent	1928		1929	
	No. of farms in group	Operator's labor earnings	No. of farms in group	Operator's labor earnings
123 and more	16	$ 761	24	$1,210
108-122	24	1,035	35	1,678
93-107	30	1,114	46	2,203
78- 92	34	1,566	38	1,936
77 and less	20	1,626	29	1,813

	1930		1931		1932	
	No. of farms in group	Operator's labor earnings	No. of farms in group	Operator's labor earnings	No. of farms in group	Operator's labor earnings
123 and more	32	—$43	26	—$1,208	31	—$1,007
108-122	33	245	26	—945	21	—1,075
93-107	48	162	45	—701	33	—801
78- 92	37	147	18	—426	29	—726
77 and less.	30	613	32	—13	29	—439

The comparisons in Table 54 indicate that size of operations had little, if any, influence on the relationship between index of power, machinery, and improvement expense and adjusted earnings.

Table 54

Average Adjusted Labor Earnings on Farms Classified According to Index of Power, Machinery, and Improvement Expense per Productive Man Work Unit and to Size of Business, 1928-32

Index of power, machinery, and improvement expense per P.M.W.U., per cent	All farms		Productive man work units					
			499 and less		500-799		800 and more	
	No. of farms in group	Adjusted operator's labor earnings	No. of farms in group	Adjusted operator's labor earnings	No. of farms in group	Adjusted operator's labor earnings	No. of farms in group	Adjusted operator's labor earnings
110 and more	246	$1,294	80	$ 799	115	$1,242	51	$2,187
90-109	264	1,702	75	1,207	116	1,612	73	2,353
89 and less	256	1,892	56	1,230	140	1,842	60	2,624

Balance in Accomplishments

In the preceding section the relation of eight organization and management factors to each other and to the earnings of the farm was discussed. Insofar as possible, the independent relationships between each of the factors and earnings were set forth. The comparisons demonstrated that under most conditions a relatively high accomplishment in each of the eight factors may be expected to have a favorable influence on earnings.

The study of the interrelation of the eight factors indicated that certain factors tend naturally to be associated with other factors. An outstanding example of such a relationship is the association between choice of crops and crop yields. On the other hand, the ability and the inclination of the farmer determine in a large measure the combinations of factors in which he excels. The extent to which better than average accomplishment in one factor is associated with better than average accomplishment in each of the other seven factors is indicated in Table 55. It is shown, for example, that of the 369 farmers who were above average in butterfat production per cow, 60.5 per cent were above average in index of returns over feed cost from livestock other than cows, 56.9 per cent in index of crop yields, 45.0 per cent in index of power, machinery, and improvement expense per productive man work unit, 37.9 per cent in index of productive man work units per worker, 49.9 per cent in index of crop selection, 55.8 per cent in productive animal units per 100 acres, and 46.1 per cent in total productive man work units. Thus the opportunity, as shown by experience, for better than average accomplishment in a variety of combinations of factors is not greatly hampered by physical limitations.

Some farmers were above the average in each of the eight factors. Some were below average in all factors. Others were above average in one or more factors. A classification of the farms according to the number of factors that were above average and the percentage of farmers in each group that were above average in the various factors are shown in Table 56. It will be noted that the bulk of the farmers were above average in three, four, and five factors. The factors in which the various groups were above average were fairly uniformly distributed among the eight factors (see Table 56). One outstanding relationship in the distribution of the factors in which the various groups were above average is the relative increase in the proportion of the farmers that were above average in crop yields as the number of factors above average increased. Good yields are to a considerable degree a primary basis for superior accomplishment in livestock production.

Table 55

Number of Farmers That Were Above Average in Each of Eight Factors and Proportion of Each Group That Was Above Average in Each of Other Factors, 1928-32

	No. of farmers above average	Percentage of total number of farms	Percentage of farmers in specified groups that were above average in: Butterfat per cow	Index of efficiency of livestock other than cows	Index of crop yields	Index of power, machinery, and improvement expense	Index of productive man work units per worker	Index of crop selection	Productive animal units per 100 acres	Productive man work units
Butterfat per cow	369	48.17	...	60.5	56.9	45.0	37.9	49.9	55.8	46.1
Index of efficiency of livestock other than cows	404	52.74	55.0	...	53.0	50.8	45.1	52.7	54.0	46.5
Index of crop yields	379	49.48	55.9	56.8	...	50.4	43.0	61.8	61.0	48.8
Index of power, equipment, and improvement expense	369	48.17	43.7	52.9	51.0	...	46.7	50.5	54.5	49.1
Index of crop selection	373	48.69	49.1	57.7	62.5	53.1	44.0	...	55.8	47.2
Productive animal units per 100 acres	366	47.78	54.9	58.2	65.0	56.1	45.7	54.1	...	46.2
Productive man work units	357	46.60	47.6	54.3	48.2	53.5	44.3	49.3	48.7	...

Table 56

Classification of Farms According to Number of Selected Factors That Were Above Average and the Percentage of Farmers That Were Above Average in Each Factor, 1928-32

Number of factors in which farmer was above average	No. of farms in group	Percentage of farmers in specified groups that were above average in: Butterfat per cow	Index of efficiency of livestock other than cows	Index of crop yields	Index of power, machinery, and improvement expense	Index of productive man work units per worker	Index of crop selection	Productive animal units per 100 acres	Productive man work units
None	11	...	...	...	...	...	...	...	...
1	49	12.2	10.2	8.1	20.4	14.2	10.2	10.2	14.2
2	108	29.6	33.3	12.9	25.0	28.7	21.2	13.8	35.1
3	140	40.0	43.5	35.7	45.7	32.1	32.8	31.4	38.5
4	175	50.2	54.2	50.8	52.5	41.1	50.8	54.2	45.7
5	149	59.0	66.4	69.1	61.7	48.9	69.1	71.1	54.3
6	91	65.9	81.3	87.9	69.2	76.9	70.3	81.3	67.0
7	36	88.8	91.6	94.4	83.3	66.6	94.4	94.4	86.1
8	7	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0

Farmers who attain better than average accomplishments in all or a majority of the organization and management factors have a well balanced business which usually may be expected to produce higher returns than can be obtained by farmers who excel in only a small proportion of the eight factors, even tho they may be outstanding in some one phase of their business. The extent to which farmers who were above average in a majority of the factors excelled those who were below average in most of the factors is indicated in Figure 17. Seven farmers were above average in each of the eight factors. The average adjusted earnings on those farms were $2,965. Thirty-six farmers were above average in seven factors. Their average adjusted earnings were $2,724. The difference in earnings resulting from the better than average accomplishment in the one additional factor (eight as compared with seven) was $241. Similar comparisons between other groups indicate a difference in earnings of approximately $275. There were eleven farmers who were below average in every factor. Their average adjusted earnings were $617, or approximately one-fifth of the earnings of the seven farmers who were above average in all of the factors.

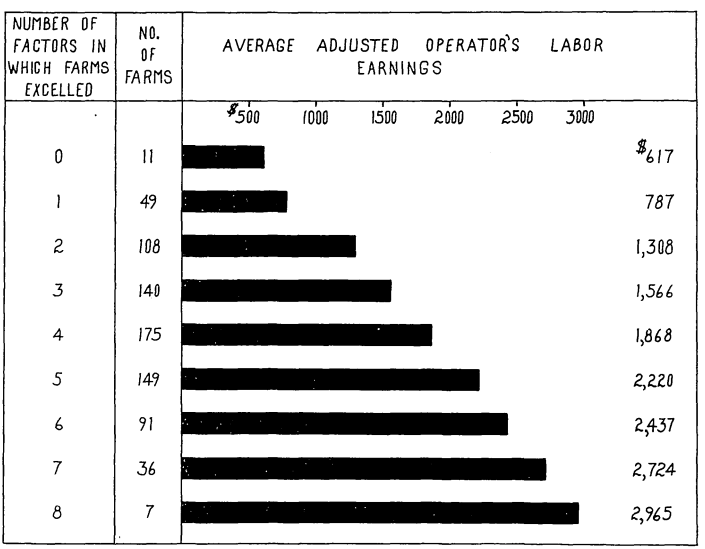

Fig. 17. Average Adjusted Operator's Labor Earnings on Farms Grouped According to Number of Selected Factors in which the Farmer was Above Average

The eight factors used as the basis of this chart are those discussed in the foregoing analysis: (1) size of business, (2) choice of crops, (3) amount of livestock per 100 acres, (4) crop yields, (5) butterfat production per cow, (6) returns over feed cost from livestock other than cows, (7) productive man work units per worker, and (8) power, machinery, and improvement expense per productive man work unit.

The foregoing comparisons that set forth the relationships between the organization and management factors and earnings should demonstrate to the thoughtful farmer that, insofar as his resources lend themselves to producing better than average results in each of the eight factors, he might well direct time and effort to improving his efficiency in the ones in which he is below average attainment. It usually is good management to specialize where experience has proved efficiency can be most readily attained, but specialization should not be carried so far as to sacrifice a well-balanced utilization of the resources of the farm.

APPLICATION TO THE FARM ORGANIZATION

The results of this study apply specifically to dairy farms in the section of the state from which the data were obtained. The same general method of study may be applied to other types of farms in other localities. The findings of such an analysis furnish an effective basis for advocating the importance of organization and management methods that will result in increased farm earnings. As such they are especially useful to the extension worker. For the individual farmer studying his own problems, it is highly important that he have records of his own business as a basis for computing these factors for his own farm. To get the greatest benefit in improving his business, he should be a member of a group of farmers keeping comparable accounts under a co-operative arrangement for providing supervision and analysis. The increased use of farm accounts in extension and research work and the recent developments in the farm management service field indicate the popularity and usefulness of this type of work to progressive farmers trying to make the most effective organization of their resources.

The authors recognize fully that the facts brought out in this analysis may not in themselves furnish a direct basis for changes in organization or management that will result in increased earnings. It may be interesting to the farmer to know that his earnings are low because his crop yields or his dairy production are low. However, unless he has the knowledge and ability with which to increase his production when he finds that it is the factor limiting his earnings, he has gained little. Information on methods of increasing crop and livestock production is made available to the farmer by the agronomist and animal husbandman. The need for such knowledge is impressed upon him by a study such as this. He is much more likely to avail himself of it than he might otherwise be.

The type of information needed in improving a farm in regard to the factors discussed in this study is also available from the farmer's

accounts. In the succeeding bulletins in this series, mentioned in the footnote on page 5, will be presented a discussion of farm practices and management methods that are followed by the farmers who achieve high ranking in these factors and hence in earnings. Attention will also be given in these later bulletins to planning the physical layout and crop and livestock organizations. Illustrations of the successful use of this type of information in improving the organization of farms will be presented to show the value of farm accounts in pointing the way to increased farm earnings.

SUMMARY

Every study of farmers' earnings reveals a wide variation among farmers, even in the same community. The purpose of this study is an analysis of the causes of these variations.

Data for this study were obtained from farm account records on dairy farms in eight counties in southeastern Minnesota. Seven hundred sixty-six farm year records for the years 1928 to 1932, inclusive, were used.

Dairying is the dominant farm enterprise in these counties and care was taken to select only dairy farms.

The farms studied averaged 185 acres in size and ranged from 40 to 680 acres. This was nearly 40 acres more than the average size of all dairy farms in the eight counties.

The selection of crops and livestock on the farms studied corresponded closely to the average for all farms in the counties covered, but the farms studied were above the average in yields of most crops and in amount of livestock maintained per 100 acres. In general, the farms studied represented the better managed farms in the area.

The average operator's labor earnings by years on the farms for which accounts were kept were: 1928, $1,260; 1929, $1,833; 1930, $211; 1931, —$650; and 1932, —$797. The "minus" earnings in 1931 and 1932 mean that the farm income in 1931 was $650 short of enough to pay the operator anything for his labor, and in 1932 was $797 short. There was an average annual range of nearly $6,000 between the lowest and highest earnings. This range was fairly constant from year to year.

Some individual farmers had consistently high or consistently low earnings, whereas others varied widely in their relative rankings from year to year.

The following eight organization and management factors were found to be associated with earnings: (1) size of business, (2) choice of crops, (3) amount of livestock per 100 acres, (4) crop yields, (5) butterfat production per cow, (6) returns over feed from livestock

other than cows, (7) labor efficiency, and (8) power, machinery, and improvement expense per productive man work unit.

Productive man work units was selected as the most satisfactory measure of size. The number of work units per farm varied from 150 to 2,313.

Crop yields and labor efficiency were higher on the large business units, but butterfat production per cow was lower. Power and machinery costs per unit of work were lower on the large farms.

In 1928 and 1929, when prices were relatively favorable, earnings increased with increases in the size of the business unit, but in 1931 and 1932 the opposite trend was observed. Large farms with high production suffered much less relative decline in earnings in 1931 and 1932 than those with low production.

An index of crop selection based on the relative profitableness of different crops in the area was used as a measure of the quality of the cropping system. Crop selection for a particular farm reflects both the farmer's judgment and the physical and economic environment of the farm.

Earnings increased with increases in the index of crop selection, but these increases were somewhat less regular during the low-price years, 1930 to 1932.

Productive animal units per 100 acres were used to measure intensity of livestock production. Intensive livestock production was associated with high crop yields and a high index of crop selection.

From 1928 to 1931 earnings increased with increases in the amount of livestock per 100 acres, but in 1932 when livestock and livestock product prices were extremely low no definite relationship was observed.

Farmers obtaining relatively high crop yields had high earnings each year of the study. The advantage of high yields was greatest on the large farms.

Farmers obtaining relatively high butterfat production per cow realized higher earnings each year. This relationship was fairly constant regardless of size of farms. Differences in earnings due to differences in butterfat production were greater on farms with low crop yields.

A relatively high return over feed cost from livestock other than cows was associated with high earnings each year. There was no association between high returns over feed from livestock other than cows and high returns over feed from cows altho there was some association between the former and butterfat production per cow.

High efficiency in the use of labor as measured by the number of productive man work units per worker was associated with high earn-

ings each year. The advantage resulting from efficiency in the use of labor was greater on the larger farms.

Low expense for power, machinery, buildings, and fences per day of productive work was associated with relatively high earnings. This association was much more marked in 1931 and 1932 than in the earlier years. Control of expenses is especially important when the prices of farm products are low.

This study, in addition to showing the individual effect of each of the eight organization and management factors on earnings, brings out the cumulative effect of better than average accomplishment in these factors. For each additional factor in which a farmer attained better than average accomplishment, there was an average increase in earnings of nearly $300.

APPENDIX

DEFINITION OF TERMS AND METHODS USED IN COMPUTING EARNINGS AND ORGANIZATION AND MANAGEMENT FACTORS

Measure of Earnings

The measure of earnings used in this study is "operator's labor earnings." This measure is computed by first adding together the cash receipts, the value of farm produce used in the house, and any increase in the value of the farm inventory. From this total is deducted the sum of cash expenses, any decrease in the value of farm inventory, the cost of boarding hired labor, an estimated value of unpaid family labor based on current costs of hired labor, and a charge for the use of capital figured at 5 per cent on the average of the opening and closing farm inventories (not including the value added to the farm by the farmer's dwelling).[12] The remainder is called "operator's labor earnings." It represents the farmer's return for his services as a laborer and manager.

All earnings data used in this publication are computed on a "full owner" basis. Some of the farms included in this study were operated by tenants. Various systems of rental, both cash and share, were used. The rental rates varied considerably among farms of similar productivity. In order to eliminate the effect of varying rental systems and rates, the earnings of all farms are computed on the basis of full ownership. All income is ascribed to the operator and all expenses such as taxes, insurance and upkeep of buildings, even tho paid by the landlord, are included in the expense statement. Some of the farms were owned free of incumbrance by the operators, whereas in other cases there was considerable indebtedness against both real estate and chattels. The rate of interest on this indebtedness varied so widely as to obscure the effect of organization and efficiency factors on earnings. All interest paid on indebtedness has therefore been eliminated from the statement of expense, and a flat 5 per cent charge is made against the entire farm investment (excluding the operator's dwelling), regardless of the amount of the owner's equity in this investment. The authors realize that both the systems of tenure and the amount of indebtedness may affect the farm organization and the practices followed. However, the effect of organization and efficiency factors on earnings can best be

[12] A multiple correlation analysis of the factors causing variations in the value of these farms indicated that the farmer's dwelling increased the value of the farm by 71 per cent of the depreciated present replacement cost of that dwelling. Therefore, in getting the value of the farm exclusive of the dwelling, only 71 per cent of the depreciated present replacement cost was deducted.

studied if the effect of varying rental and interest payments is eliminated by computing all earnings on a comparable basis.

Adjustment of Earnings

Because of the wide differences during the period 1928-32 in the yearly average of operator's labor earnings (see Table 17) it was necessary to adjust the earnings in the different years to a comparable base before combining records of different years. As indicated in Figure 7 on page 25, the differences in the annual averages were the result largely of shifts from year to year in the level of earnings rather than the result of changes from year to year in the range of earnings or in the distribution of earnings values within the range. An adjustment in the annual range to make it the same for each of the five years affected the earnings of less than 1½ per cent of the farms (see Fig. 7). With the range the same for each of the years, the earnings of the different years can be put on a comparable basis by expressing them as a percentage of the range, after minus values are eliminated from the annual arrays by adding a constant value to the earnings of each array. A measure of earnings computed in this way is a percentage or index figure.

Since the frequency distributions of the different arrays are approximately the same, comparability in the earnings in the different years is also secured by adding to the earnings of each farm the difference between the average earnings of farms of comparable size in the respective year and the average earnings of all farms of a corresponding size range in the selected base period. In obtaining the values for addition to the earnings, the farms were divided into three size (total productive man work units) groups. An illustration of this method of adjustment as applied to the earnings of individual farms is presented in Table A. The earnings for each of the five years of one individual farm in each of the three size groups are adjusted to a 1928-29 base. The 15 adjustment factors used are shown in this illustration. The period 1928-29 was used as the base period inasmuch as those two years represented a more nearly stable price situation than the three later years. Furthermore, the use of the 1928-29 base largely eliminates minus figures and to that extent makes the earnings figures more readily understood. This latter method of securing comparability will give substantially the same results in the analysis in which it is used as would the index method, if the latter was also adjusted for size of farm, and it has the advantage of being more readily understood since the earnings are expressed in monetary terms. It is therefore used in this study.

Table A

Illustration of Adjustment of Labor Earnings to 1928-29 Base for An Individual Farm in Each of Three Size Groups

Size group	Year	Actual operator's labor earnings	Adjustment factor	Adjusted operator's labor earnings
Productive man work units:				
449 and less	1928	$ 837	$ 227	$1,064
	1929	1,341	—228*	1,113
	1930	125	882	1.007
	1931	—263	1,301	1,038
	1932	—515	1,591	1,076
500-799	1928	1,177	303	1,480
	1929	1,880	—304*	1,576
	1930	290	1,435	1,725
	1931	—640	2,239	1,599
	1932	—703	2,328	1,625
800 and over	1928	2,256	276	2,532
	1929	2,869	—277*	2,592
	1930	85	2,358	2,443
	1931	—705	3,474	2,769
	1932	—913	3,545	2,632

* Minus sign (—) indicates subtraction.

Size of Business

Productive man work unit.—A productive man work unit is ten hours, or one day, of work performed on crop and productive livestock enterprises under conditions of average efficiency, or a ten-hour day of work off the farm for wages. In computing the number of units of productive crop and livestock work performed on a particular farm, the average number of ten-hour days one man was employed in caring for one acre of the different crops grown and one animal unit of the different classes of livestock kept on a group of Steele County farms, as reported in Minnesota Technical Bulletin 44, were applied to the acres of crops and numbers of animal units, respectively, on each of the farms included in the present study. The actual or estimated

Table B

Conversion Factors for Computing Productive Man Work Units

Crops			Livestock		
Kind of crop	Man hours per acre	Man work units per acre	Class of livestock	Man hours per animal unit	Man work units per animal unit*
Corn, husked	21	2.1	Cows	166	16.6
Corn, cut and shredded	28	2.8	Other cattle	76	7.6
Corn, hogged	13	1.3	Sheep	27	2.7
Corn, silage	26	2.6	Hens	201	20.1
Corn, fodder	18	1.8	Hogs	115	11.5
Sweet corn	30	3.0			
Small grains and flax	10	1.0			
Small grains, pastured	4	0.4			
Alfalfa hay	15	1.5			
Tame or wild hay	6	0.6			
Canning peas	25	2.5			
Sugar beets	40	4.0			
Potatoes	64	6.4			

* See page 81 for method of computing animal units.

number of ten-hour days of work performed off the farm for wages were added. If only the total wage received for work off the farm was reported, an average wage was used in estimating the number of days of work.

Acres in farm.—The total number of acres in the respective farms, including land in crops, pasture, farmstead, roads, and waste.

Acres in crops.—The total number of acres in harvested crops exclusive of pasture.

Investment in real estate.—The inventory value of the farm is the estimated market value of the farm as a unit less 71 per cent of the estimated depreciated replacement value of the operator's house. Inventory values were estimated as of January 1 of each year. The same values were used in 1929 and 1930 as were used in 1928. In 1931 land values were reduced approximately 32 per cent from the 1928-30 values, but no change was made in the value of buildings. This resulted in a reduction of approximately 25 per cent for real estate. In 1932 land values were reduced 31.5 per cent of the 1931 values, and buildings and improvement values were adjusted downward by 25 per cent, making an average reduction of 29 per cent on real estate. Capital losses were not included in the financial statements.

Investment in farm supplies and equipment.—Opening and closing inventory values of farm supplies and equipment were based on current market prices for all items except dairy cows. The cows that were on the farm January 1, 1928, were carried in the inventory at the January 1, 1928, values until January 1, 1931. Heifers put into the cow herd during the years 1928-30 were valued at market prices. On January 1, 1931, and January 1, 1932, cows were inventoried at market prices and these values were used for closing inventories in the respective years except as depreciation due to age or injury occurred. Capital losses incurred as a result of adjustments in inventory values at the time they were transferred from closing to opening inventories were not included in the annual financial statements.

Number of workers.—The months of labor performed by each worker were adjusted to a full-time, man-equivalent base. The adjusted months of labor performed by the different workers were then added and the sum was divided by 12. The figure obtained represents the number of full-time man-equivalent workers.

Combination of Enterprises

Index of crop selection.—The different crops grown on tillable land in southeastern Minnesota were classified into four groups on the basis of a comparison of their respective sale or feeding values yielded per acre, their effects on soil fertility, the extent to which they facilitate

the production of another crop, and their unit costs of production. The average of 1921-30 yields and prices were used in setting up the comparisons.

Table C

Classification of Crops

Class A (High returns)	Class B (Medium returns)	Class C (Low returns)	Class D (Very low returns)
Alfalfa hay	Corn for grain	Corn for silage	Corn for fodder
Alfalfa pasture	Winter wheat	Barley†	Oats
Canning peas	Flax	Oats and barley	Rye
Sugar beets	Flax and wheat	Oats and peas	Buckwheat
Potatoes*	Sweet corn	Spring wheat	Timothy hay
	Red clover hay	Succotash	Wild hay
	Red clover pasture	Field peas	Timothy pasture
	Sweet clover pasture	Soybeans	Bluegrass pasture
	Rape pasture (hogs)	Clover and timothy hay	
		Clover and timothy pasture	
		Sweet clover hay	

* Potatoes, altho in general a crop of minor importance in this area, have proven relatively profitable in limited areas to which they are especially adapted.

† The price of barley relative to that of other crops during 1933 and 1934 places the crop in Class B during these later years, but it ranked as a Class C crop during the years of this study.

The index for a particular farm was computed by adding to the acres of Class A crops one-half of the acres in Class B crops, one-fourth of the acres in Class C crops, dividing the total thus obtained by the number of tillable acres in the farm, and multiplying the quotient by 100.

Productive animal units per 100 acres.—An animal unit represents one cow, one bull, two head of young cattle, seven head of sheep, fourteen lambs, five hogs six months old or more, ten pigs under six months of age, or 100 hens kept on the farm for twelve months. These conversion factors represent the relative numbers or quantities of the different classes of livestock and poultry that will normally use the same quantities of feed. The entire acreage of the farm was used in expressing the numbers of animal units per 100 acres.

Efficiency in Production

Index of crop yields.—The index of crop yields expresses on a percentage basis the crop yields on a particular farm compared with the average yields on other farms included in the accounting study. All crops and their proportionate areas are considered. The method used in finding the crop index of a given farm was as follows:

The quantity of each field crop produced on the farm was divided by the average yield of that crop per acre on all farms, and the quotients obtained from these divisions were added and their sum divided by the crop area of the farm.

Pounds of butterfat per cow.—The production per cow was computed by dividing the total number of pounds of butterfat pro-

duced on the farm during the year by the average number of cows. Dairy products sold or consumed in the form of milk, cream, and butter were converted to a butterfat equivalent. The average number of cows was obtained by adding together the number of cows on the farm at the beginning and close of each of the twelve months of the year and then dividing the sum by 24.

Index of efficiency of livestock other than cows.—The base for livestock efficiency is the returns per unit above the cost of feed, including pasture. Feeds were valued at market prices. The returns above feed cost per animal unit of the different classes of productive livestock other than cows on each of the farms included in the accounting study were arrayed by classes of livestock. The values in each array were coded to bring the lowest figure in the array either up or down to zero. The coded values were then expressed as a percentage of the highest value in the respective arrays, the highest values of each array thus becoming 100.

The efficiency indexes thus obtained for the separate classes of livestock on each farm were combined by weighting the index for each class of livestock with the number of animal units of the respective classes on the farm, adding the weighted values, dividing the sum by the total number of animal units of all classes of livestock other than cows on the farm, and multiplying the quotient by 100. The figure obtained represents the index of efficiency (in terms of returns above feed cost) in handling livestock on the particular farm.

Index of production.—An index of livestock efficiency was combined with the index of crop yields discussed above in computing an index of production efficiency. An index of livestock efficiency was obtained by, first, computing the returns above feed cost per cow on each farm, and then proceeding in the same manner as in the computation of the index of efficiency of livestock other than cows, including the returns over feed cost from cows in the weighted index. The index of livestock efficiency thus obtained for each farm was combined with the index of crop yields for that farm by weighting the two indexes, respectively, with the number of productive man work units performed on livestock and crops, adding the weighted values, and dividing the sum by the total number of productive man work units performed on crops and livestock.

Productive man work units per worker.—The total number of productive man work units performed on the farm during one year was divided by the number of workers as defined on page 80.

Index of productive man work units per worker.—The farms included in the accounting study were classified into groups according to the total number of productive man work units performed on in-

dividual farms during one year. An average was obtained of the productive man work units per worker for the farms included in each of the groups. The productive man work units per worker on each farm was then expressed as a percentage of the average of the group into which the particular farm was classified.

Index of farm power, machinery, and improvement expense per productive man work unit.—The total farm expense (including depreciation, horse feed, fuel, repairs, and other cash outlays) associated with work horses, tractors, trucks, automobiles, gas engines, electrical equipment, general farm machinery and equipment, fences, tile drains, and buildings other than the operator's house on each of the farms was divided by the total number of productive man work units on the respective farms. The different quotients thus obtained were expressed as a percentage of their average.

Any income received from the hiring out of any of the above items was credited against the appropriate expense account.